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VIEWS, NEWS AND INTERVIEWS.

The electrical visitors to Montreal were impressed by the cheapness of that city's cab service. Many of the "carteurs" or cabmen are Irish, and the delegates were treated to some fine examples of Hibernian wit. One gentleman took a cab at the Windsor Hotel and ordered the cabby to drive to a certain store. On arriving at the store it was found that the proprietor had moved. The gentleman went into an adjoining shop to make some inquiries. The man in charge was a French-Canadian and couldn't speak English. After attempting to tell the American what he wanted to know in French the Canadian turned in despair to cabby, who had came up to hear the conversation.

"Parlez-vous Francais?" asked the Canadian, of the Irishman.

"Naw, I don't," said cabby.

"Parlez-*vous* Francais?" asked the Canadian, of the American.

"No," said the American.

"Say," said cabby, tapping the Canadian on the shoulder, "Av ye can't say ut, whoi don't ye wroite ut down?"

Another man, in driving about town on Monday, had his cab surrounded by the Labor Day parade. His Irish cabman said: "Ye'll have to get out and walk, sor, anless ye want to shpend a week here."

"Why, are we surrounded by this parade?"

"No, sor; but we're on an oisland, and can't get off."

A Springfield (Mo.) newspaper calls the man who runs the electric street cars in that town a motorneer. This is worse than referring to Warden Brown as an electrocutioner.—*New York Sun.*

The Fishkill (N. Y.) Athletic Club is a progressive organization. The members held an athletic meeting one night last week, starting the games at 8 P. M. The grounds were lighted by a number of arc lamps.

The members of the New York Electric Club will be treated to some fine lectures during the approaching Winter season. It is intended to make these lectures one of the popular features of the club, since the smoking concert proved to be such a success.

"What a pity it is to lay down a cable road in Third avenue," said an electrical engineer. "With this overhead structure of the elevated road, how easy it would be to hang a trolley wire and run electric cars. They'll come to it yet."

The following is going the rounds at the New York Electric Club:

"Why does a policeman sometimes wear rubber boots?"

"To insulate the 'copper.'"

A Powerful Electric Traveling Crane.

The Equitable Engineering and Construction Company, of Philadelphia, have installed the 100 tons' capacity electric traveling crane at the Baldwin Locomotive Works, Philadelphia, shown in our illustration on this page. Although the rated capacity of this immense machine is 100 tons, it will easily lift 150 tons. There are two of these cranes in the locomotive works, each equipped with two 40 horse-power Westinghouse constant potential motors, besides one five horse-power Wenstrom series motor, working a 1,000 lb. hoist on the far lifting trolley. Current is carried to the series motor through a flexible cable hanging in a loop at the side of the crane. The series motor moves forward and backward with the larger lifting trolley.

All the electrical engineering work was done by the Equitable Engineering and Construction Company, who have patents on all the details of electric construction.

This is the largest electric traveling crane plant in the world, and presents an impressive evidence of the power of electricity.

100 TON ELECTRIC CRANE AT THE SHOPS OF THE BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA.—LOCOMOTIVE SUSPENDED IN THE AIR.

THE PROPHET'S COLUMN.

There are in the human ear 3,000 little fibres which form the terminations of the auditory nerve. The existence of these fibres was made known by Corti, whose name they bear. Helmholtz showed that each one of these fibres is tuned to a particular note to which it responds. The principle upon which these fibres act is that which governs the production of sympathetic vibrations. If a cornet sounding the note C be played into a piano it will be found that the C string of the piano will emit that note, even after the sound of the cornet has ceased. In a similar manner one of these little filaments of the ear responds to a given note and conveys to the brain a special sensation which is always recognized as belonging to that note and which cannot be produced by any other.

It would seem to follow from this that only those notes which are represented by fibres can be perceived by the ear, and that a note having a very high or a very small number of vibrations could not produce an audible effect; that the limit of audibility would vary with different ears, some having a greater and some a less number of the fibres of Corti, and that certain animals might be able to hear sounds which are too high for the human ear.

It has been found that all of these things are true, and it is a matter of common observation that dogs and even savages are frequently much disturbed by noises which the civilized human ear cannot notice.

It would be quite possible for beings having voices pitched at a very high key, and ears to correspond, to carry on a conversation which we would be totally unable to hear. For aught we know, the air may be at all times filled with most beautiful music. We certainly know that it is constantly agitated by sounds which we cannot hear.

Shall we ever be able to listen to these unheard sounds and the mysterious music of nature which has for centuries wasted its sweetness upon the dull ear of mankind? Science answers with the phonograph, and says that by its aid we may annex, perhaps, another world.

It is conceivable that by employing a sensitive mirror vibrating a beam of light upon a moving photographic paper we may record vibrations which are too rapid for the unaided ear and then reproduce them in the phonograph at a lower pitch, thus bringing them within our range. In the same manner vibrations which are too slow to affect our ear as music might be recorded and then phonographically reproduced at a more rapid rate anywhere within our limits of audibility.

This opens up an entirely new field of research and may become a most important factor in the science of æsthetics. Perhaps it may demonstrate a numerical relation between harmony in music and in colors.

This feature of the phonograph may become of the greatest practical importance in telephony, by making it possible to carry on a number of conversations simultaneously over one circuit. The existing systems of duplex telephony are not, strictly speaking, duplex, for there is really a circuit for each conversation. By this phonographic multiplex system it would be possible to carry on one conversation in the ordinary way, then to have a phonograph transmitting a message at such a speed that the vibrations impressed upon the line should be below the audible limit of the ear and, consequently, having no effect on the original conversation. These slow vibrations could then be taken off upon a phonograph at the far end and reproduced at the normal rate. In the same way one or more separate messages might be transmitted at abnormally high rates and reproduced at the usual speed. Of course, a multitude of practical difficulties exist, but there are no theoretical reasons in the way of this accomplishment. The working speed of the telephone line in the present state of the art is the most serious obstacle to be encountered. But this factor depends principally upon electro-static capacity; and while no scientist has yet practically overcome the retardation which it introduces, the significant fact remains that no one can prove that this trouble cannot be avoided on circuits of ordinary dimensions.

THE PROPHET.

A Model New York City.

The following notice has been sent to members of the Electric Club, and a large attendance will undoubtedly be present:

The Club will resume its entertainments on Thursday, September 24, 1891, at eight P. M., when Mr. Allen R. Foote, the special agent for the collection of the statistics of the electrical industry for the eleventh census, will read a paper on "The Making of a Model New York City."

This paper will deal, in an original manner, with the industrial and social needs of the city; the problems of rapid transit and workingmen's homes, and the relation borne by electricity to the evolution of a perfected New York.

ECHOES FROM MONTREAL.

ADDITIONAL EXHIBITION AND OTHER NOTES.

The Aluminum Carbon Company, of Buffalo, N. Y., was represented by Mr. F. V. Doty.

The Falls Rivet and Machine Company, of Cuyahoga Falls, was ably represented by President Babcock.

There were a number of gentlemen present representing various companies that were not exhibitors.

W. H. Gordon & Company, New York, made no exhibit, but were well represented by Mr. W. H. Gordon.

Samples of glass jars and battery carbons were shown by the Peru Glass and Carbon Company, of Peru, Ind.

George Cutter, of Chicago, was on hand to exhibit and explain his lamp supporting pulley in active operation.

Mr. C. H. McIntyre exhibited samples of the McIntyre connectors made by C. McIntyre & Company, of Newark, N. J.

The Ellis oil filter, which is well known to central station men, was exhibited by the Standard Oil Filter Company, of Chicago.

A neat and well patronized exhibit of in the interest of the Pettingell-Andrews Company, whose well-known, "K. W." cut-outs and rosettes were exhibited by the Toronto Electric Construction and Supply Company.

Mr. F. A. Magee, of Boston, and Mr. W. S. D. Crane, of New York, exhibited samples of the Anderson trolley, the Ætna lamp hanger, the Underwood cotton leather belting and indurated fibre pipe, for the Engineering Equipment Company, of New York and Boston.

The Hill Friction Clutch Company, of Cleveland, Ohio, were represented by Miller Brothers & Toms, of Montreal, who exhibited samples of the Hill friction clutch, which is well known in electric light stations the country over.

Mr. H. Ward Leonard was handicapped by having to hobble around on crutches. He had a bad knee, the result of a carriage accident, but pluckily carrried out his plans of attending the convention and making an exhibit of his new electric power system.

Maybe the Custom House officials didn't have the wrath of the gods called down upon their heads! They were overwhelmed by the quantity of exhibits. The Collector

FIG. 1.—VIEW OF EXHIBIT OF INTERNATIONAL OKONITE COMPANY, LIMITED, AT MONTREAL ELECTRICAL EXPOSITION.

The World's Fair Electrical Congress.

Press dispatches from Chicago, dated September 18, inform us that within the last week preliminary arrangements for an electrical congress at the World's Fair have taken definite form. A committee of the World's Fair Congress Auxiliary has been appointed by President Bonney, with Prof. Elisha Gray, chairman; Col. Robert C. Clowry, vice-chairman, and B. E. Sunny, C. H. Summers, G. H. Bliss and F. S. Gorton as members. Several other prominent gentlemen have been invited to serve on this committee, but their acceptances have not yet been received. This committee will have charge of all forms of electrical application, except electrical engineering, which has been assigned to the General Committee on Engineering Congresses, and electro-therapeutics, which has been assigned to the Committee on Health and Medicine.

The Electrical Congress will deal, among other things, with telegraphy, telephony, the phonograph and telautograph, the electric light, the electric motor, and all other practical applications of modern electricity, except those otherwise especially assigned. This local committee will be assisted in its work by an advisory council of the World's Congress Auxiliary, consisting of the most distinguished electricians in different parts of the world. On this advisory council will doubtless appear the names of Cyrus Field, Thomas A. Edison, Alexander Graham Bell, Elihu Thomson and scores of others distinguished in this particular field, although less widely known throughout the world.

Edison phonographs was shown in active operation by Holland Brothers & Young, of Montreal.

The Bridgeport Brass Company was represented by Messrs. Chas. A. Hamilton and Henry D. Stanley—two very handsome and dignified gentlemen.

Mr. R. Vose distributed small samples of fuse wire, which had been accurately tested by the Massachusetts Electrical Engineering Company, of Boston.

Mr. A. S. Clark, of Boston, was present in the interest of the American Circular Loom Company, of Boston, upon whose wire the moon never sets.

Mr. J. M. Orford represented the Union Electric Manufacturing Company, of Bridgeport, Conn., as well as the Bridgeport Electric Light Company.

Messrs. Royce & Marean, of Washington, District of Columbia (not the State of Washington), was represented by Fred. W. Royce, the junior member of the firm.

The New England Butt Company, of Providence, was represented by an attractive catalogue that was sought for by the many wire manufacturing companies.

A unique gavel made of Okonite wire and cable was presented to President Huntley by the International Okonite Company, Limited. It was handsome and serviceable.

Mr. W. F. Cullen exhibited some glassware and electric light specialties in his room at the Windsor Hotel. He represented the E. P. Gleason Manufacturing Company, of New York.

Mr. C. B. Price, of Boston, was present of the Port and Inspector Cooney, who was in charge of the exhibition hall, lent valuable experience to the exhibitors.

The Royal Electric Company placed six colored arc lights on the tall mast in the park in front of the Windsor Hotel. Besides these there were two white lights which were used there every night. The Royal Company did this at their own expense. The lights made a very fine appearance.

The handsome illustrations which we presented last week were made from photographs taken by William Cumming, the leading photographer of Montreal. Mr. Cumming is thoroughly equipped for doing this kind of work, and put himself to considerable personal inconvenience to assist the REVIEW in the matter.

Mr. N. V. Titus represented the Economic Electric Manufacturing Company, of Boston, makers of the "Economic" incandescent lamps. The booth of the Canadian Electric Construction, Supply and Manufacturing Company, in which were shown samples of Simplex wire, was illuminated by 150 "Economic" lamps.

Belanger Freres, Montreal, distributed printed matter illustrating and describing a number of electrical specialties and supplies for which they are agents. Among these specialties were the Leclanche batteries, Bogart's automatic burners, Guion automatic heat regulators and annunciators, push buttons, etc., made by Belanger Freres.

The Heisler Electric Light Company, of Philadelphia, whose exhibit we illustrated last week, were much disappointed that they were unable to procure power to operate

their dynamo. They write us as follows: "We would, under no circumstances, have made any display had we known it would be impossible to show the apparatus in full operation. We regret the circumstances exceedingly, not alone for ourselves, but for the many individuals who visited the exhibition who were interested in our apparatus, especially in the operation of it. You will readily understand that the apparatus standing there to be looked at, was not satisfactory to those interested in electric lighting, much less satisfactory to us. We would respectfully request that you make mention of this fact in the form of a notice to your many readers, extending to them our regrets at being unable to show our apparatus in operation, and assure them that it was not our fault, as we made every effort possible to secure the necessary power, but failed."

A TRIP AND A PRESENTATION.

[Written for the REVIEW by Dr. A. F. MASON.]

After the adjournment of the National Electric Light Association, and after the famous trip on Richelieu river, about 50 of the delegates and members visited the Citadel City of Quebec. They were guided by Mr. A. J. Corriveau and Mr. Mohr, manager of the Quebec Electric Light Company. On Sunday they were taken in carriages to the Citadel, over the Heights of Abraham and through the city generally, visiting the Basilica and other points of interest.

On Monday the party were taken in carriages to the Montmorency Falls. On the heights above the Falls is the ancient building which a century ago was the home of the Duke of Kent, the father of Queen Victoria. Into the grand old home they were welcomed by Mr. and Mrs. Hall, who now own this beautiful place. A royal lunch was spread and a delightful hour was spent with this hospitable gentleman and lady. From the veranda of their house one looks over the mighty St. Lawrence River, which here is two miles wide. The continuous roar of the falling waters of Montmorency, as it makes its grand leap of 250 feet over a perpendicular precipice, made fair music in perfect diapason. The waters of this river furnish an inexhaustible power, which is utilized for the running of large mills, and also for the Quebec electric light station. We missed the night view from this point. We are told that at this season the Aurora Borealis shoots its continuous rockets into the dark northern air, but that, splendid as are these natural scenes, they are outrivaled by the illumination of the Citadel and city of Quebec, lit by electric lights six miles distant, and which form a half circle of several hundred suns, each equal to the splendid Venus when at her brightest, all reflected in the still waters of the river below.

This wonderful water power is controlled by Messrs. Hall and Price. The water is conducted from above the falls in large pipes to the mills and to the electric light station. In this station are 16 dynamos, supplying the current for 300 arc lights and two 750 light machines for incandescent lighting. Over 1,200 miles of conductors are in use. More dynamos are being built for this station, their present supply being all inadequate to meet the demand.

On Monday the party returned to Montreal, and on Tuesday Mr. Corriveau was the most surprised man in that city. In behalf of the members remaining in Montreal an elegant gold headed cane was presented to Mr. Corriveau. Mr. A. F. Mason, in making the presentation, said to Mr. Carriveau, "Sir, during the last week certain gentlemen have had their eyes upon you and have observed conduct of yours which they cannot overlook, and however painful the duty, they feel called upon formally to take this notice thereof; in fact, they have determined to cane you. Before doing this, I am instructed to read you this formal communication:

"MONTREAL, September 15, 1891.

"Mr. A. J. Corriveau, Montreal, Canada.

"Dear Sir:—A few of your many friends, members of the National Electric Light Association, desire to express their appreciation of your successful efforts to make their visit to Canada a joyful one. They will ever remember your untiring labors in their behalf, culminating in the Quebec and Montmorency Falls trip, which has been the climax of eight days of rare enjoyment.

"No words and certainly no material gift could adequately represent our sentiments, yet we are unwilling to leave you without some token that, in days to come, may recall to your mind the happiness you have been instrumental in conferring upon us.

"We therefore beg you to accept, as a slight token of our esteem, the walking stick which the undersigned are commissioned to hand you. We are, Cordially yours,

"W. J. MORRISON,
"A. F. MASON,
"W. J. HAMMER,
"*Committee.*"

Mr. Morrison presented to Mr. Corriveau the cane. After this episode the members of the Association scattered, and so ended the grandest meeting so far held by the National Electric Light Association.

A Swiss Electric Launch.

There is now in daily service at the Frankfort Electrical Exhibition the electric launch "Zurich," built at Zurich, Switzerland. Last May, when the boat was completed, a

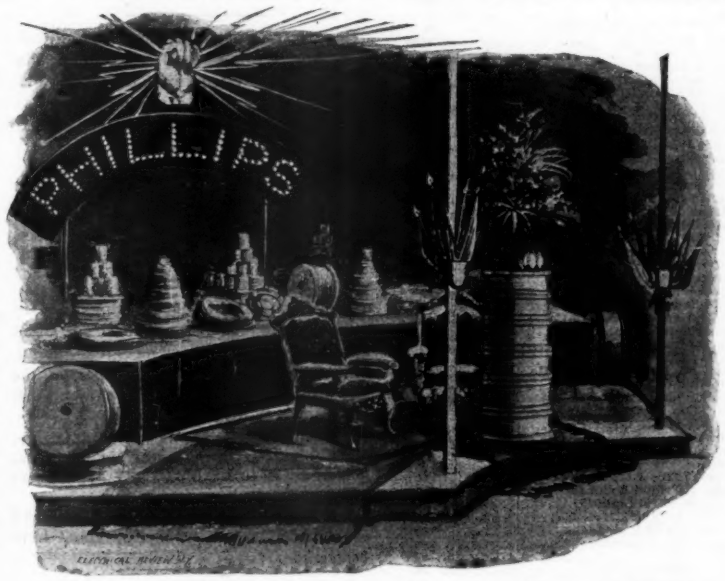

FIG. 2.—VIEW OF EXHIBIT OF THE EUGENE F. PHILLIPS ELECTRICAL WORKS, LIMITED, AT MONTREAL ELECTRICAL EXPOSITION.

trial test of it was made. United States Consul Catlin, of Zurich, writes this account of the trial:

"Zurich's remarkable activity in the field of electric invention has, within the last few days, been newly demonstrated by the trial trip of the new electric accumulator boat 'Zurich,' which took place here on the 7th instant.

"The shores of the lake were lined with spectators curious to witness the novel spectacle. The trial proved in every way successful, and, as the event may be said to introduce a new era, or, at all events, to mark a long step forward in navigation, a description of the boat is undoubtedly of interest and value. It is claimed for it that it is the first of its kind on the European continent and the largest in existence anywhere. England has already built some smaller ones, accomodating 30 or 40 passengers, while this one has room for from 80 to 100. Its length is about 50 feet, its draft 4 feet, and its total weight about 16 tons, including machinery and accumulators, which alone weigh about 6½ tons. With the exception of the lever for stopping the current, the steering wheel, and the apparatus for regulating the amount of power to be applied (amperometer and voltameter), the deck is clear of all machinery. In the hold where the machine room is located, there are ranged in order no less than 56 accumulators for storing the electric power, which is thence transmitted to the dynamo machine, the armature of which, thus set in motion, communicates directly with the screw propeller. On the trial trip, the revolutions varied from 248 to 365 per minute.

"The accumulators, which are an invention of the machine factory at Oerlikon, near this city, vary from those hitherto in use, both in the form of their construction and in the use of a gelatinous electrolyte for decomposition by the electric current. The latter does not act directly upon the leaden plates themselves, but upon oxide of lead placed in the interstices of lead gratings, the lead itself serving merely as bearer and conductor of the current. The gratings are constructed with triangular openings, and are provided with two channels instead of one, for conducting the current. The system of plates, when placed perpendicularly, is such that the positive current is conducted by the upper, and the negative by the lower corners, thus insuring a more equable distribution of the stream and a longer use of the plates.

"The rate of speed attained on the trial trip was highly satisfactory. A course of about three miles was covered in 25 minutes and 25 seconds, showing a speed of about eight miles per hour. A good average of 6½ miles per hour may be counted upon for longer trips. One man can manage the boat, a single movement of the lever sufficing to set the craft in motion, either forward or backward, or to stop it. It is also said to obey the rudder readily. The cost of the 'Zurich,' as the new boat is called, is between $5,000 and $6,000."

FIG. 3.—SIMPLEX ELECTRICAL COMPANY'S BOOTH AT MONTREAL ELECTRICAL EXPOSITION.

Dayton, Ohio.—The Dayton Fan and Motor Company; capital, $20,000.

Chillicothe, Mo.—People's Gas and Electric Company; capital, $50,000.

Defiance, Ohio.—The Defiance Light and Power Company; capital, $100,000.

Henderson, N. C.—The Henderson Light and Power Company; capital, $10,000.

Aracoma, W. Va.—Aracoma Telephone and Telegraph Company; capital, $500,000.

Carthage, Ill.—The Carthage Electric Light and Power Company; capital, $10,000.

East St. Louis, Mo.—The Waterloo Electric Light and Power Company; capital, $10,000.

Chicago, Ill.—Garden City Electric Company; F. O. Busting, president; capital, $10,000.

New York, N. Y.—National Ticker Company, incorporated in West Virginia; capital, $500,000.

Chicago, Ill.—The Electrical Construction Company has increased its capital from $25,000 to $50,000.

La Junta, Colo.—Dr. B. F. Haskins, president, has organized an electric light company, not named, to light the town; capital, $15,000.

Boston, Mass.—Dow Adjustable Light Company, to manufacture and deal in adjustable drop lights, electric appliances and novelties; capital, $5,000.

Chicago, Ill.—Chicago and Evanston Elevated Electric Railway Company; John Lewis Cochrane, president; capital, $2,000,000. Road is to run north 12 miles along shore of Lake Michigan to Evanston.

Long Distance Power Transmission an Accomplished Fact.

It is reported that the tests of the Lauffen-Frankfort long distance transmission of power system has been successfully tested. It is said the experiment passed off without a hitch and the apparatus works perfectly. "In view of the immense strength of the electric energy passing through the cable the most extraordinary precautions have been taken to prevent injury to life or limb. As the current is conveyed by the roadside, along the telegraph line, notice boards in the shape of deaths' heads have been affixed to each pole, with the words, 'Do not touch.' Warnings have also been generally issued, pointing out the danger of fastening any animal or vehicle to the poles, or bringing them within dangerous proximity of the wires. Schoolmasters have been requested to warn the children not to approach the lines or fly kites near the wires.

"The electric lamps in the exhibition here were lighted by the current transmitted from the generating center at the Lauffen Falls of the Neckar, over 100 miles distant from this city. The various authorities of Wurtemberg, Baden, Hesse and Prussia, through whose territory the cable passes, formerly took over the undertaking, and subsequently made it over to the General Electricity Company, of Berlin, and to the Oerlikon Machine Works, of Switzerland, the constructors of the plant and electrical appliances. It was found that the precautionary measures adopted along the cable line to insure the safe transmission of the electric current were faultless. The representatives of the Wurtemberg authorities had assembled at Lauffen itself, the generating center, while the representatives of the Baden and Hesse authorities, together with Herr von Miller, representing the exhibition; Herr Ebert, representing the Imperial Postal Department; Herr von Dobrowolski, representing the Electricity Company; and Professor Weber, of the Testing Committee, met at Eberbach, on the confines of Baden and Hesse, where they made some experiments. The transmission of the electrical current derived from water power over a distance of 108 miles is, therefore, an accomplished fact."

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Many compliments upon the ELECTRICAL REVIEW of last week have reached this office. We think they are deserved, but our modesty won't permit us to say so.

The next gathering of electrical men will be at Pittsburgh, on the occasion of the convention of the American Street Railway Association, which begins October 21. The wonderful strides electric power has made in this direction will undoubtedly result in a very large attendance of the representatives of electrical manufacturers, as well as the leading street railway men of the country. Col. Henry M. Watson, of Buffalo, is the president of the Association, and Mr. W. J. Richardson, of Brooklyn, is the secretary.

New York is the filthiest city in America—probably of any on this globe. How long will her citizens permit her streets to remain in their present condition?

It is encouraging to note that progress is being made toward holding a World's Fair Electrical Congress. These congresses in the past have been of inestimable value to electrical science, and the field will have developed to such an extent by the time the World's Fair is held that another congress for the establishment of standards and other work will be almost a necessity.

One of the effects of consolidating and transforming the St. Paul and Minneapolis street railway systems into one company, with electricity as the motive power, is seen in the discontinuance of trains between St. Paul and Minneapolis, by the Great Northern Railway Company. Formerly this company did the local passenger traffic between the twin cities, but the competition of the electric company has become so keen that it has taken off from 15 to 20 trains.

What can be more encouraging or soul-satisfying to the manufacturer of street railway motors and appliances than the following words, taken from the report of the Executive Committee of the New York State Street Railway Association?

"This Association in its meeting this year, as in that of a year ago, has but one idea, however, and that is, electricity as a motive power."

If this Association is to have one grand central idea, no better selection could have been made.

In a letter to the New York *Tribune* Mr. Lasell, of Athens, proposes a system of nomenclature for electrical execution as follows: "Electroplexy, the method; electroplectron, the instrument; electroplex, the person suffering the penalty. To make this clear, the last part of the word comes from the verb 'pletto,' to strike, and means also to suffer an evil." Doubtless the subject would be equally ghastly under this as well as another name. Holocaust, holocausty, holocausted, would be just as euphonious, and truer to life in point of realistic definition. Instead of wasting energy in coining names, however, time would be better spent in an effort to coin a statute repealing the law.

In a recent editorial discussing the appearance of the sodium line in the spectra of lightning and other electric discharges, we suggested that the presence of ozone might have an important bearing on the phenomenon, although admitting that the sodium line of the Bunsen burner rather tended to prove the existence of sodium in the atmosphere. We have received a note from Mr. Dittrich, chemist of the Ozone Manufacturing Company, enclosing some data going to show the presence of ozone even in the flame of a Bunsen burner. This would seem to give additional weight to our original suggestion that ozone might in some way be concerned in the results obtained by Mr. Wood.

CONSISTENCY APPLIED TO ELECTRIC ROADS.

Foreigners visiting the United States and Americans who have returned home from abroad frequently remark upon the universal plastering of advertising signs upon every conspicuous object within the range of vision.

The New York elevated railroads and most of the large railroads have their stations, waiting rooms and road-beds lined with glaring signs which obtrude themselves impudently upon the view, to the almost utter exclusion of any landscape which may exist.

Americans, and especially New Yorkers, are said to be the most easily imposed upon and tolerant people in the world in matters pertaining to personal comfort.

If all these atrocious advertising signs are tolerated why should such a howl go up about "disfiguring the streets" when overhead trolley wires are mentioned?

THE TELEPHONE ABROAD.

In the issue of the REVIEW for March 28 last we published a special article from the pen of Mr. Herbert Laws Webb, on the London-Paris telephone line, in which the actual construction and electrical conditions of the line were described for the first time on this side of the water. At the recent meeting of the British Association, at Cardiff, Mr. W. H. Preece, the chief electrician of the British Postal Telegraphs, read an interesting paper on the working of this line, which is certainly one of the most noteworthy of recent developments of long distance telephony.

The electrical conditions of the line are practically those stated in the REVIEW article referred to, as by actual measurements of the resistance and capacity the KR is found to be 7,359, whereas Mr. Webb placed it by calculation at 7,167. Several trials were made of extending the line to different points in Paris and London, these connections being made through ordinary gutta-percha covered underground wires having high resistance and capacity, and although sometimes as much as four or five miles of such wire was added to the line, speaking was always possible. These experiments clearly show that there is a good margin for extension from the terminals of the line by employing properly constructed overhead circuits. As a further proof of this, speech was carried on between London and Brussels, a distance of about 500 miles, and, with some difficulty, between London and Marseilles, a distance of over 900 miles.

An extensive trial was made of transmitters of different types, eleven transmitters having been experimented with. Those which emerged triumphantly from these trials were the Ader, D'Arsonval, Gower-Bell, Roule and Western Electric long distance instrument (of the type used for long distance work in this country.) These five transmitters were adjudged to be approximately of equally good quality.

As regards the business done over the line, we are pleased to see that Mr. Preece has a very satisfactory report to make. We confidently predicted the commercial success of the line at the time of announcing its completion, and we are glad to learn that there is a very considerable demand for the service, at the tariff of two dollars for three minutes' conversation. The average number of talks per day, exclusive of Sunday, is 86. The maximum has been 108. There have been as many as 19 conversations in one hour, the average being 15 during the busy hours of the day. As an instance of what can be done with a long distance telephone circuit, Mr. Preece states that 150 words per minute have been dictated in Paris and taken down in London by a stenographer. This is at the rate of five words for two cents, or one-tenth of the cost of a telegram between the same two points, thus affording a striking illustration of the remark we made in a previous writing as to the advantages which long distance telephone service frequently possesses over the telegraph.

Mr. Preece, in describing the effect of the static charge and sudden discharge caused in a metallic circuit by thunder clouds, gives us the explanation of the stories which have from time to time reached us through the newspapers about people having been knocked from their seat at the telephone by lightning discharges. With a copper circuit, as there is no electro-magnetic inertia present, the charge induced in the circuit, owing to the electric field set up by the thunder cloud, will cease suddenly when the cloud discharges. This sudden release of the charge produces a short, sharp crack in the receivers like a pistol report at one's very ear. The start at hearing such a report has more than once thrown the listener off his stool, and has led to the belief that he was knocked down by lightning. As a matter of fact, there is no danger and no possibility whatever of receiving a shock.

Mr. Preece's article, referred to above, appears in full in this issue.

CORRESPONDENCE.

OUR LONDON LETTER.

Russian Exhibition.—Under the auspices of the Russian government there is to be an international exhibition at Odessa in 1894.

The British Association.—The new president-elect of the British Association is to be Sir Archibald Seikie. Next year's meeting will be held in Edinburgh, commencing August 3.

The Brush Electrical Engineering Corporation, Limited.—The central offices of this company have now been removed from Belvidere Road to their premises in Queen Victoria street, city, facing the Mansion House station.

Rome.—At the end of the present year the streets of Rome will be lighted by electricity. The current is to be transmitted by electric wire from Tivoli, distant about 30 kilometres from Rome. The first street to be lighted will be the Via Nazionale.

Lyons.—The Lyons Tramway Company, after a trial of nearly all locomotive systems, has now centered upon a series of trials with an accumulator car. It carries 112 cells, weighing two and one-half tons, and the total weight when loaded is 11 tons. The result has been very satisfactory and the directors appear inclined to introduce other electric tram cars.

The 1893 Crystal Palace Electrical Exhibiton.—At this International Exhibition, Her Majesty's government will exhibit historical telegraphic and electrical apparatus, instruments and appliances, as well as the modern apparatus and instruments now in use in the Postal Telegraph Department. It will be under the superintendence and direction of Mr. W. H. Preece, F. R. S.

The Liverpool Overhead Electric Railway.—The power on the Liverpool Electric Railway is to be obtained from motors on each car and not from an electric locomotive. By this means there will be greater economy of traction, as there is plenty of room for the fitting of motors under the carriages, an arrangement, however, which was impossible in the restricted space in the tunnel of the South London line.

Brighton.—Mr. Shoolbred has informed the lighting committee of the Brighton town council that the works at the generating station were now so far advanced the corporation would be in a position to supply electricity to the public not later than September 15. It was also recommended that Messrs. Sharp and Kent's offer to wire and fit up lamps at the station for £205 should be accepted, and the committee's recommendation was finally adopted.

The London Electric Company and Mr. Ferranti.—There is at last an authoritative statement in regard to Mr. Ferranti's severance with the London Electric Company. Mr. Ferranti's engagement as chief engineer to the corporation was coincident with his post of contractor, and the Deptford station has now been completed for 100,000 lamps, of which, however, only 30,000 are at present taken up. Had not the need for economy necessitated there is no doubt the interests of the company would have been served by a renewal of his engagement. Mr. Ferranti is now devoting his whole time and energy to the development of his Charterhouse Square business.

The Frankfort Exhibition.—About 20 members of the electrical trades section of the London Chamber of Commerce left for Frankfort on Monday last. The Electrotechnical Congress has written assuring them of every welcome. With regard to the transmission of power, Professor Ayrton writes from the Electrical Exhibiton, Frankfort-on-the-Main, on August 28: "As there has been rumors that the transmission of power from Lauffen to Frankfort was not going to succeed, you may be interested to hear that I saw to-day some 900 sixteen candle glow lamps in the exhibition at Frankfort supplied with current produced by water power at Lauffen, 175 milometres away, some 12,000 volts being used in the transmission. So some 50 or 60 horse-power has been transmitted."

Mr. L. J. Crossley.—It is with the greatest regret I have to record the death last week of Mr. Louis J. Crossley, J. P., at his residence, Moorside, Halifax. In telephone circles, as the designer of the very successful transmitter known as the Crossley Transmitter, his name is a household word. Born in 1842, he began before he was 20 years of age to take a keen interest in electricity. In association with Mr. Brequet, a leading French electrician, he took out as one of his earlier inventions a patent known as the alphebetical instrument, of which many thousands were sold. He was one of the first members of the Society of Telegraph Engineers and remained a member up to his death. When Professor Graham Bell's invention of the telephone was announced Mr. Crossley secured the first brought into this country and had it fixed to the wires at Dean Clough, in the place of the Crossley-Brequet instruments then in use. Discovering there was a lack of efficiency for commercial purposes he set himself to improve, and finally took out a patent for the Crossley transmitter, by means of which a message was rendered more audible. For this patent he ultimately received £20,000 from the United Telephone Company. He was well-known and thoroughtly appreciated in the town of Halifax and through Yorkshire generally.

CHARLES FFRENCH.

London, April 12, 1891.

OUR CHICAGO LETTER.

Mr. C. A. Benton, manager of the street railway department of the Detroit Electrical Works, was a recent visitor in Chicago.

The Electric Merchandise Company, through their general salesman, Mr. D. B. Dean, have just secured the entire order of line material for six miles of electric railway, to be built by the Lockport Electric Railway Light and Power Company, of Lockport, N. Y.

Mr. Wm. Hood has been out of the city for a fortnight. He has been in St. Paul arranging for the installing of the big 600 cell accumulator plant at the residence of Mr. Jas. J. Hill, President of the Great Northern Railroad. Indications are that he will also bring back some nice orders for "Jewel" lamps.

Col. L. W. Burnham, of the Electric Gas Lighting Company, of Boston, has been spending a few days in Chicago overseeing the opening of their branch store, the company having decided to open a branch and carry a small stock at least. Mr. C. E. Lee, who has had a large electrical experience, is in charge. Mr. Lee has been for some time connected with a large supply house, and should do a desirable business from the start.

L. W. C.

Chicago, September 19.

OUR BOSTON LETTER.

A party of leading business men of Georgia, mostly from Augusta, visited Boston on Friday.

Messrs. Perry & Demeritt, of Montpelier, Vermont, are manufacturing a new system of driving dynamos.

H. E. W. Palmer, Southern agent of the Thomson-Houston Company at Atlanta, is in Boston on business.

Manager Howard, of the Tropical American Telephone, has returned to his office in this city, after enjoying a month's vacation.

The Electrical Trade of the "Hub" will be largely represented at the Montreal Convention of the National Electric Light Association.

The Attleboro Electric Bell Company has recently been established in Attleboro, Mass., for the manufacture of electric house furnishings. Mr. A. R. Macomber is the manager.

Another Electric Railway.—It is authentically reported that an electric road will soon be built between Conway, N. H., and the station of the Boston and Maine Railroad, four miles distant.

Bell & Blake Patents, having lapsed in Great Britain and Canada, opens up the telephone field in those countries to active competition. The Tropical American Telephone Company is apparently the first of the opposition telephone companies to appreciate the opportunities and grasp the situation.

The Annual Meeting of the Eastern Electric Supply Company was held at 65 Oliver street, Friday, September 11. These officers were elected: President and manager, Maybin W. Brown; vice-president, W. B. Ferguson; secretary and treasurer, Albert Otis Smith. These, with L. A. Dean and D. J. Hern, constitute the board of directors.

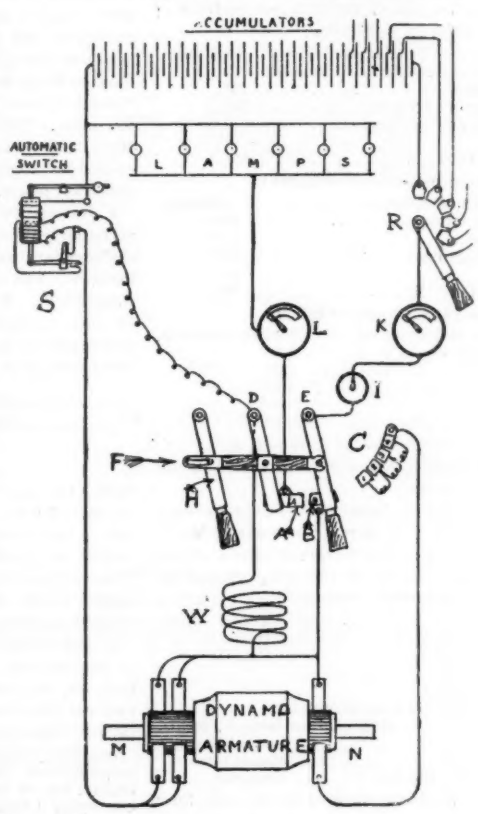
Boston, Sept. 19, 1891. W. I. B.

Our Convention Issue.

We have received so many good words of praise from all parts of the country regarding the superiority of the last issue of the ELECTRICAL REVIEW, which covered the Montreal Electric Light Convention, that we think it may be of some interest to our readers to know a little of the labor involved in the production of such an issue.

To begin at the beginning, way back last Spring, when it was decided to hold the next meeting of the National Electric Light Association in Montreal, arrangements were entered into with the Windsor Hotel to secure accommodations for the editors who were assigned to this convention and a parlor for receiving the friends of the REVIEW. When the exhibition was well started arrangements were made for space in the skating rink from which to distribute copies of the REVIEW and such information as was desired. Then came the more direct preparation of shipping bundles of REVIEWS to Montreal and arranging for transportation facilities for the members of the staff who were to attend.

Arriving at Montreal on the special train Sunday night, it took the greater part of Monday to get the papers and other matter through the custom house. Then these had to be arranged for distribution. In the meantime the proceedings of the convention and the opening of the exhibit were going merrily on. One member of the staff kept his eye close upon Mr. Ryan, the official stenographer, and as fast as he and his assistants turned out their report the editor digested it in his capacious maw and forwarded it by special delivery to members of the staff at the home office in New York. From the length of the proceedings it can readily be understood what a herculean task it was to follow up and get the report in shape to be easily read by subscribers to the REVIEW.



THE SCOTT-SISLING SYSTEM FOR CHARGING ACCUMULATORS.

Besides the report, the various social functions, excursions and the exhibits had to be covered in full. Notes of these happenings were made during the day, to be written out in full at night, and forwarded as quickly as possible to the editorial rooms at New York, and from there sent to the printer's hands.

It took some time, of course, to get the handsome illustrations, which we printed last week—and these were deemed of sufficient importance to send a member of the editorial staff from Montreal to New York with them. They were rushed into the hands of the engravers, with explicit instructions to make them in no time at all.

Returning from Montreal, the usual routine of making up a large journal was pursued. The "dummies" were made up from "galley" proofs, sent to the printers, pages were made up, proof returned for correction—all of which were read several times and revised as often—and the page proof returned to the printers. Then the pages were arranged in forms, the forms were put on the press, other proofs were taken and submitted for approval, and, finally, the presses were set humming to strike off the thousands of copies required for our readers.

It required the undivided efforts of our staff, working day and night, to accomplish the results shown in our last issue.

Charging Accumulators in Private Installations for Electric Lighting.

Private installations generally involve the use of accumulators, and to charge these the dynamo voltage must, of course, be raised some 25 per cent. above the lamp voltage. In many cases this is inconvenient and wasteful, as the dynamo must be "run up" to this increased voltage, although only a portion of the current generated may be used for charging, the remainder being required for the lamps at the normal voltage.

We illustrate a neat arrangement devised by Messrs. W. B. Sisling and W. H. Scott, of Norwich, England, which seems to overcome this difficulty, and has several features which ought to prove advantageous in a private installation. The arrangement may be described as a compound dynamo with a small supplementary winding on its armature connected to an extra accumulator, which gives a voltage usually about one-quarter of that given by the main commutator. A branch is taken from the main circuit and connected so that the extra commutator raises its voltage by about 25 per cent. This forms the charging circuit. The dynamo can thus be driven at constant speed, and will supply constant voltage to the lamps from its main circuit undisturbed by the increasing voltage from the cells during charging. The whole of the cells can be charged and a large current supplied to the lamps at the same time, as this does not pass through the regulating cells. The charging can, therefore, be accomplished during the hours of lighting instead of the dynamo having to be run specially during the day.

The diagram shows the general arrangement. The dynamo armature has a main commutator M, and an extra commutator N. These two commutators are connected in series, either directly or through the dynamo series winding W. The switchboard contains two switches, viz., the dynamo switch D, which connects the dynamo to the lamps, and the accumulator switch E, which connects the accumulators in either of three different ways, viz:

A to the lamps alone, or
B to the lamps and dynamo, or
C to the charging circuit.

These two switches are of the lever pattern, and are interlocked by the thrust rod F. The handle H acts on the thrust rod so that it can only put the dynamo switch "on." To take it "off" the accumulator switch must be moved so that the accumulators are connected to the lamps alone. When the dynamo switch is put "on" the thrust rod moves the accumulator switch from A to B, thus connecting the accumulators to the dynamo in such a way that they are in readiness to assist the dynamo in supplying current to the lamps without risk of weakening or reversing its magnetism. If the dynamo does not need assistance, and spare power is available, the accumulator switch may be moved further from B to C, when the dynamo will begin to charge the cells by means of its extra commutator N, without interfering with the constant voltage which is supplied to the lamps from its main commutator M. An index I shows whether the accumulators are being charged or discharged, whilst an ammeter K indicates the *amount* of the charging or discharging current. A second ammeter L shows the current taken by the lamps. A pilot lamp on the switchboard lights when the dynamo starts up.

By means of this arrangement the manipulation is made simple and the charging current can be adjusted to form a complementary load, thus working the plant at its maximum efficiency and shortening the hours of running.

The arrangement is in use in some private installations, the latest being one erected for Baron V. de Barrets, of Bandon Park, Suffolk, which is driven by an oil engine giving 11 B. H. P. The engine is started by the accumulators, and these also work the coil which ignites each charge in the engine cylinder.

The whole arrangement seems to work satisfactorily and without specially skilled attention, which is an important matter for country houses.

Removal of the James Kempster Printing Company.

The well-known printing house of the James Kempster Printing Company, and one of the largest printing houses of the city, has been compelled to move, on account of growing business, from 56 Cedar street to larger and more convenient quarters at 117, 119 and 121 Liberty street. The transfer of so large an office, without permitting it to interfere with the regular output of the company, was accomplished last week quite successfully, and the new office is now running very smoothly. The printing establishment will occupy all of the building except the street floor, where the extensive New York offices of the Roebling's Sons Company, the owners of the building, are located.

Telephonic News

*** Representatives of Bell Telephone Company in Washington, D. C., say that the trunk line of 50 wires, now being constructed between New York and Chicago, will be completed within four months.

*** The Cincinnati Telephone Exchange has issued a new directory for September, 1891. The cover is handsomely printed in colors, and the directory is indexed. It is considerably larger than the last previous issue.

*** The merchants and many of the residents of Demerara, Barbadoes and Trinidad individually own their telephone instruments, and are stockholders in their respective telephone companies. Not only do they get good telephone service, but also derive a fair income from dividends.

*** The French military manœuvres include the use of elaborate apparatus by the balloon, telegraphic, postal and telephone services, to which General Saussier has given great attention. If successful, every army corps will be provided with a complete outfit, including a portable steam engine to work dynamos. It has been ascertained that one hour will suffice to inflate a balloon and provide it with a telephone.

*** The Tropical American Telephone Company has recently furnished the Colonial Secretary at Grenada, West Indies, with a complete outfit for a central office telephone system similar to those in successful operation at Barbadoes, Trinidad, St. Kitts, St. Lucia and Antiqua, West Indies. The telephone service established on the islands named, respectively, was promoted, and the equipment furnished, by the Tropical American Telephone Company.

New Work of the New England Telephone and Telegraph Company.

This progressive company has just installed a new multiple switchboard in their exchange at Salem, Mass., which will accommodate 600 subscribers at present, with an ultimate capacity of 1,000 subscribers. The office is handsomely fitted up and is one of the finest in New England.

They are now installing a new multiple switchboard at Portland, Me., in a new building purchased a short time ago. The present capacity of the board is 1,000 subscribers, with an ultimate capacity of about 2,000. The third floor of the building is occupied as an operating room, distributing room, girl's retiring room, bath rooms, etc. One-half of the second floor is occupied by the Superintendent's office of the Eastern Division.

A contract has been closed for the erection of a handsome building on Albion street, in Boston, which will be occupied exclusively by one of the central offices of the Boston exchange. The building is 45x50, two stories and basement. A new multiple switchboard has been ordered for this office with an ultimate capacity of 2,400 subscribers' lines, 600 ex-territorial and trunk lines.

A new multiple switchboard is now being installed in Holyoke, Mass., with a present capacity of about 400 subscribers' lines and an ultimate capacity of about 800.

The Portland-Boston line is being rebuilt, larger and heavier poles being used, and, as soon as completed, another metallic circuit will be placed upon these poles, making three metallic circuits between the above points. They have about completed the rebuilding of their line between Northampton, Mass., and Bellows Falls, Vt., through Greenfield and Brattleboro. When this line is completed another copper metallic circuit will be placed upon these poles between the points named.

The London-Paris Telephone.

A PAPER READ BEFORE THE BRITISH ASSOCIATION BY W. H. PREECE, F.R.S.

1. I have already on two occasions, at Newcastle and at Leeds, brought this subject before Section G, and have given the details of the length and construction of the proposed circuit. I have now to report not only that the line has been constructed and opened to the public, but that its success, telephonic and commercial, has exceeded the most sanguine anticipations. Speech has been maintained with perfect clearness and accuracy. The line has proved to be

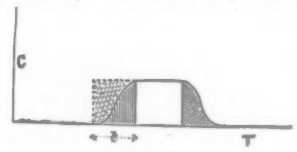


FIG. 1.

much better than it ought to have been, and the purpose of this paper is to show the reason why.

The lengths of the different sections of the circuit are as follows:

London to St. Margaret's Bay	84.5	miles.
St. Margaret's Bay to Sangatte, (cable)	23.	"
Sangatte to Paris	190.	"
Paris underground	4.8	"
Total	311.3	"

The resistances are as follows:

Paris underground	70	ohms.
French line	294	"
Cable	143	"
English line	183	"
Total (R)	693	"

The capacities are as follows:

Paris underground	0.43	microfarads.
French line	3.33	"
Cable	5.52	"
English line	1.32	"
Total (K)	10.62	"

$$693 \times 10.62 = 7{,}359 = K\,R,$$

a product which indicates that speech should be very good.

2. *Trials of Apparatus.*—The preliminary trials were made during the month of March between the chief telegraph offices of the two capitals, and the following microphone transmitters were compared:

Ader	Pencil form.
Berliner	Granular "
D'Arsonval	Pencil "
De Jongh	" "
Gower-Bell	" "
Post Office switch instrument	Granules and lamp filaments.
Roulez	Lamp filaments.
Turnbull	Pencil form.
Western Electric	Granular.

The receivers consisted of the latest form of double-pole Bell telephones with some Ader and D'Arsonval receivers for comparison. After repeated trials it was finally decided that the Ader, D'Arsonval, Gower-

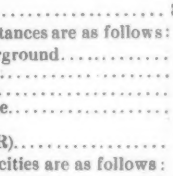


FIG. 2.

Bell (with double pole receivers instead of tubes), Roulez and Western Electric were the best, and were approximately equal.

These instruments were, therefore, selected for the further experiments, which consisted of using local extensions in Paris and London. The wires were in the first instance extended at the Paris end to the observatory through an exchange at the Avenue des Gobelines. The length of this local line is seven kilometres. The wires are gutta-percha covered, placed underground, and not suitable for giving the best results.

The results were, however, fairly satisfactory. The wires were extended to the treasury in London by means of the ordinary underground system. The distance is about two miles, and although the volume of sound and clearness of articulation were perceptibly reduced by these additions to the circuit, conversation was quite practicable.

Further trials were also made from the Avenue des Gobelines on underground wires of five kilometres long, and also with some renters in Paris with fairly satisfactory results. The selected telephones were equally

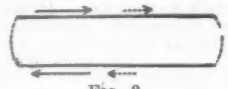


FIG. 3.

efficient in all cases, which proves that to maintain easy conversation when the trunk wires are extended to local points it is only necessary that the local lines shall be of a standard not lower than that of the trunk line. The experiments also confirm the conclusion that long-distance speaking is solely a question of the circuit and its environments, and not one of apparatus. The instruments finally selected for actual work were Gower-Bell for London and Roulez for Paris.

3. The results are certainly most satisfactory. There is no circuit in or out of London on which speech is more perfect than it is between London and Paris. In fact, it is better than I anticipated, and better than calculation led me to expect. Speech has been possible not only to Paris but through Paris to Bruxelles, and even, with difficulty, through Paris to Marseilles, a distance of over 900 miles. The wires between Paris and Marseilles are massive copper wires specially erected for telephone business between those important places.

4. *Business Done.*—The charge for a conversation between London and Paris is eight shillings for three minutes' complete use of the wire. The demand for the wire is very considerable. The average number of talks per day, exclusive of Sunday, is 86. The maximum has been 108. We have had as many calls as 19 per hour—the average is 15

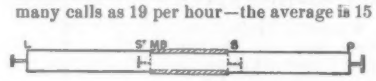


FIG. 4.

during the busy hours of the day. As an instance of what can be done, 150 words per minute have been dictated in Paris and transcribed in London by shorthand writing. Thus, in three minutes, 450 words were recorded, which, at eight shillings, cost five words for a penny.

5. *Difficulties.*—The difficulties met with in long-distance speaking are several, and they may be divided into (*a*) those due to external disturbances, and (*b*) those due to internal opposition.

(*a.*) Every current rising and falling in the neighborhood of a telephone line within a region, say, of 100 yards, whether the wire conveying it be underground or overground, induces in the telephone circuit another current, producing in the telephone a sound which disturbs speech, and if the neighboring wires are numerous and busy, as they are on our roads and railways, these sounds become confusing, noisy and ultimately entirely preventative of speech. This disturbance is, however, completely removed by forming the telephone circuit of two wires, placed as near each other as possible, and twisted around each other without touching, so as to maintain the mean average distance of each wire from surrounding conductors the same everywhere. Thus similar currents are induced in each of the two wires, but being opposite in direction, as far as the circuit is concerned, they neutralize each other, and the circuit, therefore, becomes quite silent.

In England we make the two wires revolve completely round each other in every four poles, but in France it is done in every six

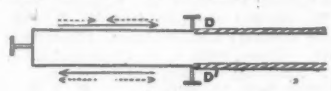


FIG. 5.

poles. The reason for the change is the fact that in the English plan the actual crossing of the wires takes place in the span between the poles, while in the French plan it takes place at the poles. This is supposed to reduce the liability of the wires to be thrown into contact with each other by the wind, but, on the other hand, it diminishes the geometrical symmetry of the wires—so very essential to ensure silence. As a matter of fact, contacts do not occur on well-constructed lines, and I think our English wires, being more symmetrical, are freer from external disturbance than those in France.

(*b.*) The internal opposition arises from the resistance, R, the capacity, K, and the electro-magnetic inertia, L, of the circuit. A current of electricity takes time to rise to its maximum strength and time to fall back again to zero. Every circuit has what is called its time constant, t, Fig. 1, which regulates the number of current waves which can be transmitted through it per second. This is the time the current takes to rise from zero to its working maximum and the time it takes to fall from this maximum to zero again, shown by the shaded portions of the figure; the duration of the working current being immaterial and shown by the unshaded portion. The most rapid form of quick telegraphy requires about 150 currents per second, currents each of which must rise and fall in $\frac{1}{150}$th of a second, but for ordinary telephone speaking we must have about 1,500 currents per second, or the time which each current rises from zero to its maximum intensity must not exceed $\frac{1}{3000}$th part of a second. The time constant of a telephone circuit should therefore not be less than .0003 second.

Resistance alone does not affect the time constant. It diminishes the intensity or strength of the currents only; but resistance, combined with electro-magnetic inertia and with capacity, has a serious retarding effect on the rate of rise and fall of the currents. They increase the time constant and introduce a slowness which may be called retardance, for they diminish the rate at which currents can be transmitted. Now, the retardance due to electro-magnetic inertia increases directly with the amount of electro-magnetic inertia present, but it diminishes with the amount of resistance of the conductor. It is expressed by the ratio $\frac{L}{R}$ while that due to capacity increases directly both with the capacity and with the resistance, and it is expressed by the product, K R. The whole retardance, and, therefore, the speed of working the circuit or the clearness of speech, is given by the equation

$$\frac{L}{R} + K\,R = t$$

or

$$L + K\,R^2 = R\,t.$$

Now, in telegraphy, we are not able altogether to eliminate L, but we can counteract it, and if we can make $R\,t = 0$, then

$$L = -\,K\,R^2,$$

which is the principle of the shunted condenser that has been introduced with such signal success in our post office service, and has virtually doubled the carrying capacity of our wires.

If, in the above equation, we make $L = 0$

$$K\,R = t.$$

This is done in telephony, and hence we obtain the law of retardance, or the law by which we can calculate the distance to which speech is possible. All my calculations for the London and Paris line were based on

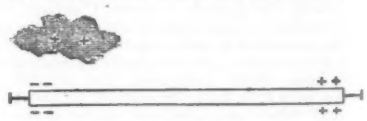


FIG. 6.

this law, which experience has shown to be true.

How is electro-magnetic inertia practically eliminated? First, by the use of two massive copper wires, and secondly, by symmetrically revolving them around each other. Now, L depends on the geometry of the circuit: that is, on the relative form and position of the different parts of the circuit, which is invariable for the same circuit, and is represented by a coefficient, λ. It depends also on the magnetic qualities of the conductors employed and of the space embraced by the circuit. This specific magnetic capacity is a variable quantity, and is indicated by μ for the conductor and by μ_0 for air. It depends also on the rate at which currents rise and fall, and this is indicated by the differential coefficient $\frac{d\,C}{d\,t}$. It depends finally on the number of lines of force due to its own current which cut the conductor in the proper direction; this is indicated by β. Combining these together we can represent the electro-magnetic inertia of a metallic telephone circuit as

$$L = \lambda\,(\mu + \mu_0)\,\frac{d\,C}{d\,t} \times \beta.$$

Now, $\lambda = 2 \log \frac{d^2}{a^2}$. Hence the smaller we make the distance, d, between the wires, and the greater we make their diameter, a, the smaller becomes λ. It is customary to call the value of μ for air, and copper, 1, but this is purely artificial; and certainly not true. It must be very much less than one in every medium, excepting the magnetic metals, so much so that in copper it may be neglected altogether, while in the air it does not matter what it is, for by the method of twisting one conductor round the other, the magnetism of the air space by the one cur-

rent of the circuit rotating in one direction is exactly neutralized by that of the other element of the circuit rotating in the opposite direction. Now, β, in two parallel conductors conveying currents of the same sense, that is flowing in the same direction, is retarding, Fig. 2, and is therefore a positive quantity, but when the currents flow in opposite directions, as in a metallic loop, Fig. 3, they tend to assist each other and are of a negative character. Hence, in a metallic telephone circuit, we may neglect L *in toto* as I have done.

I have never yet succeeded in tracing any evidence of electro-magnetic inertia in long single copper wires, while in iron wires the value of L may certainly be taken at .005 henry per mile.

In short metallic circuits, say of lengths up to 100 miles, this negative quantity does not appear, but in the Paris-London circuit this helpful mutual action of opposite currents comes on in a peculiar way. The presence of the cable introduces a large capacity practically in the centre of the circuit. The result is that we have in each branch of the circuit between the transmitter, say, at London and the cable at Dover, extra currents at the commencement of the operation, which, flowing in opposite directions, mutually react on each other, and practically prepare the way for the working currents. The presence of these currents is proved by the fact that when the cable is disconnected at Calais, as shown in Fig. 5, and telephones are inserted in series, as shown at D and D', speech is as perfect between London and St. Margaret's Bay as if the wires were connected across, or as if the circuit were through to Paris. Their effect is precisely the same as though the capacity of the aerial section were reduced by a quantity, M, which is of the same dimension of character as K. Hence, our retardance equation becomes

$$R(K-M)=t.$$

Thus it happens that the London-Paris telephone works better than was expected. The nature of M is probably equivalent to about .0075 ϕ per mile, and therefore K should be also about .0075 ϕ instead of .0156 ϕ per mile. This helpful action of mutual induction is present in all long circuits, and it is the reason why we are able to speak to Brussells and even to Marseilles. It also appears in every metallic loop, and vitiates the measurement of electro-magnetic inertia and of capacity of loops. Thus, if we measure the capacity of a loop as compared with a single wire, the amount per mile may be 50 per cent. greater than it ought to be; while if we measure the capacity of one branch of a circuit under the conditions of the London-Paris telephone line, it may be 50 per cent. less than it ought to be. This effect of M is shown by the dotted line in Fig. 1.

Telephonic currents—that is, currents induced in the secondary wire of an induction coil due to the variation of microphonic currents in the primary wire—are not alternating currents. They do not follow the constant periodical law, and they are not true harmonic sine functions of the time. The microphonic currents are intermittent or pulsatory, and always flow in the same direction. The secondary currents are also always of the same sign, as are the currents in a Ruhmkorff coil and as are the currents in high vacua, with which Crookes has made us so familiar. Moreover, the frequency of these currents is a variable quantity, not only due to the various tones of voices but to the various styles of articulation. Hence, the laws of periodic alternate currents following the sine function of the time fail when we come to consider microphones and telephones. It is important to bear this in mind, for nearly everything that has hitherto been written on the subject assumes that telegraphic currents follow this periodic sine law. The currents derived from Bell's original magneto-transmitters are alternate, and comply more nearly with the law. The difference between them and microphones is at once perceptible. Muffling and disturbance, due to the presence of electro-magnetic inertia become evident, which are absent with microphones. I tested this between London and St. Margaret's and found the effect most marked.

7. *Lightning.*—A metalic telephone circuit may have a static charge induced upon it by a thunder cloud, as shown in Fig. 6. Such a charge is an electric strain which is released when the charged cloud flashes into the earth or into a neighboring cloud. If there be electro-magnetic inertia present the charge will surge backward and forward through the circuit until it dies out. If there be no electromotive-force present it will cease suddenly and neutrality will be attained at once. Telephone circuits indicate this operation by peculiar and characteristic sounds. An iron wire circuit produces a long swish or loud sigh, but a copper wire circuit like the Paris-London telephone emits a short, sharp report, like the crack of a pistol, which is sometimes startling, and has created fear, but there is no danger or liability to shock. Indeed, the start has more than once thrown the listener off his stool, and has led to the belief that he was knocked down by lightning.

8. The future of telephone working, especially in large cities, is one of underground wires, and the way to get over the difficulties of this kind of work is perfectly clear. We must have metallic circuits, twisted wires, low resistance and low capacity. In Paris, a remarkable cable, made by Fortin-Herman, gives an exceedingly low capacity—viz., only .069 ϕ per mile. In the United States they are using a wire insulated with paper which gives .08 ϕ per mile. We are using in London Fowler-Waring cable, giving a capacity of 1.8 ϕ per mile, the capacity of gutta-covered wire being 3 ϕ per mile.

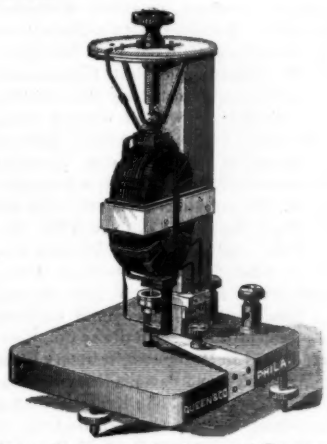
Queen's New Type of Siemens' Electro-Dynamometer.

Siemens' electro-dynamometer is an instrument too well known to electricians to require any description. The ease with which it may be standardized, even by those not familiar with instrumental work, its constancy and freedom from variable elements, and its immediate applicability to the measurement of either direct or alternating currents, has placed it in the hands of all those requiring to make accurate measurements of such currents. With a view to improving certain weak points in the type commonly made as well as to producing a more convenient and perfect instrument, Queen & Company, Philadelphia, have designed a form of electro-dynamometer, a cut of which is shown.

The principal change made in this form from the usual form is the suspending of the movable coil by means of a polished agate center instead of by a coarse fibre. On account of the variable absorption of moisture by the fibre and the mechanical constitution of the fibre itself, a certain sluggishness and insensitiveness of action has always characterized the instrument. In Queen & Company's type, the coil hangs by a small hardened steel center in a cup center of highly polished agate. The coil, hung in this way, is absolutely free from any perceptible friction, and the sensitiveness of the instrument is very greatly increased. To reduce the moment of inertia of the suspended coil, an index made of light aluminum wire has been used instead of the usual heavy brass index. Just below the agate a small brass pin extends downward and fits into a cylindrical opening a trifle larger, in a rubber block clamped to the upper part of the movable coil; hence, by releasing the spring, shown on the base, the coil is lifted from its agate and held tightly, so that despite the roughest handling in transportation, the jewel cannot be broken, while the steel center will accurately reseat itself in the agate, owing to the guidance of the pin, when the spring is depressed by means of its screw. Instead of two uprights, as in the Siemens' made type, Queen's design employs but one, thus considerably lightening the instrument as well as making its working part more accessible. The binding posts are placed at the rear of the instrument instead of in front, thus getting the connecting wires out of the way.

The instrument is thus far wound to but two ranges, viz: from $\frac{5}{10}$ to 20 amperes, and from 1 to 60 amperes. Other sizes will be made for higher and lower ranges of current as soon as possible. Each instrument is furnished with two sets of windings—thus in the 20 ampere type one set allows measurements to be made varying from $\frac{1}{10}$ to about 4 amperes, while with the other set, the range entends from about 1 to 20 amperes.

The whole instrument is finally finished in polished mahogany and lacquered brass and copper. The dial is of opal glass and graduated in 400 equal divisions. These instruments are also being made inclosed in glass cylinders and with brass instead of wood support, a silvered instead of opal dial, and otherwise more handsomely finished.



QUEEN & COMPANY'S SIEMENS' ELECTRO-DYNAMOMETER.

Cutter's Conduit Connector.

In all well conducted stations the connection of the circuits is inspected daily and pains are taken to locate and remedy any fault. This holds for underground as well as for overhead lines, although it is often more difficult to find the leak when the wires are buried. Thus to find the fault in an underground arc circuit which winds through many streets is not the easiest problem. If different sections of the circuit could be readily disconnected, the leak could be quickly traced to some particular locality and speedily remedied. A device for this purpose has now been put on the market by George Cutter, of Chicago, in the shape of a conduit connector. This has two slotted sleeves which are soldered to the ends of the wire, the connection being made by a screw-plug. These metal parts are imbedded in hard rubber and a cap of the same material closes the whole tightly. On removing the screw-plug the line is opened at this point, and is accessible for testing.

CUTTER'S CONDUIT CONNECTORS.

The other form shown in the cut is used with lead covered cables. It has the rubber insulation fitted into a metal shell which slips over the ends of the lead cable and is soldered to it. With either form it takes but a minute to disconnect a section or to make contact with it in order to test the insulation resistance of the cable.

TELEGRAPHIC

.... McGinnis, the telegraph operator accused of tapping telegraph wires engaged by the Turf Commission Company, was tried at Montreal last week and acquitted.

.... An International Code Directory is now in course of preparation at the Berne International Telegraph Office. At the International Telegraph Conference, held last year at Paris, it was decided by the delegates that an international dictionary of code words, which would be accepted by all countries in international telegrams, should be prepared for the next conference. This is the work now in hand at Berne.

Timing a Cannon Ball by Electricity.

Captain Heath has been burning a lot of powder this Summer in the big guns at the United States proving ground at Sandy Hook, and to people who don't know a big gun from a mortar the most interesting part of these tests has been the method by which the initial velocity of the projectiles has been determined. At Sandy Hook a delicate electrical appliance called the Boulanger chronograph measures this velocity accurately and records its own measurements. This is the way it does it:

In testing the large guns at these proving grounds two open frames are set up in front of the gun at a distance of 150 feet from each other. Wires are stretched back and forth across each of these frames, making a screen through which the projectile must pass. The wires in each of these screens form a complete electric circuit which includes also an electric battery and an electro-magnet. When the gun is fired the projectile breaks the wire in the first screen, interrupts the circuit, and at the same time the armature of the magnet is released. In a very small fraction of a second the projectile has covered the distance to the second screen and interrupted its circuit, releasing another armature. The interval of time between the drop of these two armatures represents the time taken by the projectile to travel 150 feet.

This period is so short that it is hardly conceivable. The chronograph, however, registers it accurately. Wires run from each of these screens to the laboratory near them, where are placed the chronographs, batteries, switchboard and other apparatus. The two electro-magnets in circuit with the screens are embodied in the chronograph. The first magnet has as an armature an iron rod about three feet long, which is suspended in a vertical position from its core. When the wires of the first screen are broken this iron rod falls. When the shot ruptures the wire of the second screen the armature of the second electro-magnet, which is placed a short distance below the first, is also released. It operates as a knife, and striking the side of the falling rod makes a slight mark. The distance through which the rod drops while the shot is passing from one screen to the other is indicated by the distance of the cut from the end of the rod. From this the corresponding interval of time is easily computed, and this forms the unit for the calculation of the projectile's velocity in feet per second. When it is necessary to obtain very accurate records several chronographs may be used for testing the same shot.

Of course, the rate of a projectile's velocity diminishes rapidly during its flight from the gun, and the calculations of the initial velocity must be confined to a short portion of its path immediately after it leaves the gun. Instantaneous photographs are obtained of the projectile as it strikes the target. From these experiments in velocity the ordnance officer is able to determine the relative strength of different powders.—*New York Sun.*

Reception at the Young Men's Institute.

The Young Men's Institute, a branch of the Y. M. C. A., at 222-224 Bowery, New York city, will give a special reception to steam engineers, machinists and metal workers on Wednesday evening, September 23.

The programme of courses of instruction at the institute for the coming year are of the usual practical and sensible character.

* * Galion and Bucyrus, Ohio, are raising money to build an electric street railroad between the towns.

* * Work on the electric street railway connecting Lawrence, Mass., with Andover, North Andover and Methuen is almost completed, and before many days the electric cars will be in operation. The superintendent and directors are confident that when completed it will be one of the best constructed electric roads in the State.

* * The general term of the Supreme Court in Kings County has appointed John Winslow, J. J. Mareau and Marshal S. Driggs as commissioners to examine and report on the application of the Coney Island and Brooklyn Railroad Company, known as the Jay and Smith Street Line, to change its motive power from horses to the trolley electric system, on the route from near the city line on Fifteenth street to Ninth avenue and Ninth street. The commission have 60 days' time to make their report.

* * The Short Electric Railway Company has closed a large number of contracts for "Gearless" motors for fall delivery. It will commence shipments from the first factory order, now nearly completed at its works, early in September, and the motors will shortly be running in St. Louis, Mo.; Albany, N. Y.; Louisville, Ky.; Indianapolis, Ind.; Washington, D. C.; Lincoln, Neb.; Rochester, N. Y.; Houston, Tex.; Harvey, Ill.; Cleveland, Ohio; Pittsburgh, Pa.; Wilkesbarre, Pa.; Brooklyn, N. Y.; Hot Springs, S. Dak., etc.

* * In view of the rapidly increasing demand for electricity as a motive power for street railways, it is well to glance over what has already been done in that direction. In 1886 there were three electric railways in operation, running 13 cars; to-day there are in operation in this country, England, Germany, Italy, Austria and Japan, not less than 325 roads, running 4,000 cars and 7,000 motors, with 2,000 miles of track, making a daily mileage of not less than 400,000 miles, and carrying 750,000,000 passengers. It is estimated also that one-fourth of the street railways in the United States are being operated wholly or in part by electricity. And all this has been accomplished in less than five years.

* * The Cincinnati, O., Inclined Plane Railway Company have recently extended their electric lines so that they now run from the government buildings, in the heart of Cincinnati, out to Carthage, Ohio, 10 miles away, passing through Mt. Auburn, Corryville, St. Bernard, and other suburbs. This company operates two power stations, one at the head of the Inclined Plane and the other near St. Bernard. The former is equipped with four steel tubular Tudor boilers, one 16x16 Ball automatic cut-off engine, one 18x42 Greenwald automatic cut-off engine, two 80,000 and four 50,000 watt Edison generators. The other station has three Tudor boilers, one 20x48 Greenwald engine and two 80,000 watt Edison generators.

* * One of the largest of the recent electric railway contracts has just been closed by the Short Electric Railway Company, covering the equipment of four of five street railways in and around Wilkesbarre, Pa. The Wilkesbarre and Wyoming Valley Traction Company, of which Mr. B. F. Meyers, of Harrisburg, is president, has been formed to consolidate the railways in Wilkesbarre, and the long, narrow valley containing a number of prosperous townships. Senator Jno. J. Patterson is one of the interested parties. The roads are to be equipped electrically at a cost of over $200,000, and the Short Company has secured the contract for dynamos, motors, "Gearless" type, and about 40 will be required for present necessities. It is intended to make this one of the most perfectly equipped roads in the country.

STREET RAILWAY ASSOCIATION.

THE NEW YORK STATE ASSOCIATION HOLDS ITS ANNUAL MEETING AND LISTENS TO AN EXCELLENT PAPER ON ELECTRIC POWER—SARATOGA THE NEXT MEETING PLACE.

The ninth annual meeting of the Street Railway Association of the State of New York was held at the Hotel Metropole, New York city, on Tuesday, September 15, 1891. President Daniel F. Lewis called the meeting to order at 11 A. M.

The following delegates were present:

John N. Beckley, president Rochester Railway Co., Rochester; Edwin Beers, president Broadway Railroad Co., Brooklyn; John M. Calhoun, president Forty-second Street and Grand Street Ferry Railroad Co., New York city; Duncan B. Cannon, secretary Brooklyn City and Newtown Railroad Co., Brooklyn; Frank Curtiss, president Sixth Avenue Railroad Co., New York city; Wm. H. Delaney, superintendent North and East River Railroad Co., New York city; C. J. Field, engineer Buffalo Railway Co., Buffalo; John S. Foster, president Forty-second Street M. and St. N. Ave. Railway Co., New York city; Benjamin Graham, vice-president Rochester Railway Co., Rochester; Daniel B. Hasbrouck, secretary Houston, West Street and Pavonia Ferry Railroad Co., New York city; John Kruesi, president Schenectady Railway Co., Schenectady; E. T. Landon, auditor Dry Dock, E. B. and B. Railroad Co., New York city; George Law, president Eighth Avenue Railroad Co., New York city; Daniel F. Lewis, president Brooklyn City Railroad Co., Brooklyn; George W. Linch, secretary Christopher and Tenth Street Railroad Co., New York city; H. H. Littell, president The Cross-town Railroad Co., Buffalo; L. H. McIntyre, superintendent Harlem Bridge, M. and F. Railway, New York city; Thomas H. McLean, secretary Twenty-third Street Railway Co., New York city; John W. McNamara, president Albany Railway Co., Albany; Milton I. Masson, secretary Central Cross-town Railroad Co., New York city; C. K. Minary, general manager Rochchester Railway Co., Rochester; Col. John N. Partridge, president Brooklyn City and Newtown Railroad Co., Brooklyn; W. J. Richardson, secretary Atlantic Avenue Railroad Co., Brooklyn; G. Hilton Scribner, president Central Park, N. and E. R. Railroad Co., New York city; Henry Thompson, president Broadway Railroad Co., New York city; Johnson L. Valentine, treasurer Central Park, N. and E. R. Railroad Co., New York city; Henry M. Watson, president Buffalo Railroad Co., Buffalo; C. Densmore Wyman, vice-president Central Park, N. and E. R. Railroad Co., New York city.

There were also present the following street railway officials: Thomas C. Barr, president People's Passenger Railway Co., Philadelphia, Pa.; Edward J. Lawless, superintendent Paterson Railway, Paterson, N. J.; Lewis Perrine, president Trenton Horse Railroad Co., Trenton, N. J.

The street railway and electrical press were represented as follows: Charles W. Price, ELECTRICAL REVIEW; T. C. Martin, *Electrical Engineer*; C. E. Stump, C. B. Fairchild and J. H. McGraw, *Street Railway Journal;* F. L. Kenfield, *Street Railway Review;* P. G. Monroe, *Street Railway Gazette;* E. V. Cavell, *Street Railway News;* J. B. Taltavalt, *Electrical Age.*

After the calling of the roll the first order of business was the address of the president, from which we give the following extract:

ADDRESS OF THE PRESIDENT.

The past year has been one of prosperity to the street railway companies of this State; it has been comparatively free from severe snow storms; it has been free from epidemics among horses; the receipts from passengers show a good average increase; no adverse legislation of a general character was effected, and last but not least, no labor disturbances have taken place. In referring to the latter I feel that the heated experiences of the past few years have been of great benefit; the outcome has established a basis for the conditions under which employés of street railways should labor, and especially so as to the number of hours which should constitute a day's work, and also the proper compensation therefor; it has also brought capital and labor closer together in having the employés better enlightened on this subject; in 1885 and 1886, the years the agitation in labor began among street railways, employés in all classes and grades of labor knew but one side of the question; they did not understand the relation capital and labor bore to each other, and in this condition of mind their demands were so much greater than capital could bear that strife followed, and the result has finally placed each in equitable positions, and, I believe, there to remain until something radical shall occur to either advance or deplete the profits of the street railway business, which might again relatively and properly affect the hours of labor and pay of men in such service.

We have reason also to congratulate ourselves on the benefits which will accrue to street railways, growing out of the Court of Appeals' decision in the case of The People *vs.* The Union Trust Company, of New York, which provides the manner in which assessors shall treat the capital stock of corporations for purposes of assessment.

It very plainly holds that all corporations deriving profit from its capital stock shall only be assessed on the par value thereof, and that surplus earnings shall be exempt from assessment to the extent of 10 per cent. of the capital of any such corporation.

For many years (except the past two, when we were very kindly treated) bills have been introduced in the legislature which have affected, or would affect the interests of street railways in all parts of the State, and at times very seriously so; and I may ask, who looks after such legislation? In answer I can say, that when it is looked after at all it is done by the companies in large cities. But is this right? Should not the smaller companies contribute their share of labor and attention? Are not their interests quite as great, in proportion, as any other company's? Are not their interests as dear to them? Should a small company take refuge under the protection of a large company because it is large, and not render a service which is at its command? They should be glad, because they are small and comparatively weak, to render any assistance they can, in order that their share might be done in behalf of the protection they get and need.

The street railway interest, I fear, is not aware of the power behind it; if the gentlemen representing it would only stop for a moment and think that the solid vote of their employés and the vote they could command, would often turn the majority of the State one way or the other at elections, it would then comprehend what it might be capable of doing in emergencies. I refer to this only to show that any very radical action which the legislature might undertake and which might cripple companies to a point where the employés would be seriously affected, would result disastrously to any party in case a political issue should be made of it, and anything so radical might very likely be so engineered if the proper management were at hand.

Then came the report of the Executive Committee, from which the following is taken:

The horse is with us, and always will be, in a greater or less number. For his sake, however, we devoutly hope that, as a motive power for street cars, his days, not years, are numbered.

Cable power is having its full share of attention, as is evidenced by the transformation into cable roads of the lines on the two leading business throughfares of the metropolis.

This Association in its meeting this year, as in that of a year ago, has but one idea, however, and that is electricity as a motive power.

While such companies as the Third Avenue and the Broadway and Seventh Avenue demonstrate the courage of their convictions by launching out upon an expenditure of millions, most of us must perforce make haste slowly; and we, therefore, turn our attention to electricity! The people want an improved motive power, *i. e.*, an improvement over horses; and surely the most brilliant and magnetic, the loftiest and most promising motive power, based upon what we see and hear, is electricity. Thus it comes to pass that your committee has arranged for the preparation of another report upon electric motive power for street surface railways, by the president of a company whose lines are operated by this subtle and withal fascinating power. Participation in the discussion of this subject by men eminent on the surface as well as overhead has also been arranged for.

The treasurer's report was presented, and showed as follows:

Receipts during year.....	$1,097.64
Expenses " "	959.48
Balance on hand.....	$138.16

This was followed by the report of the special committee on "Electric Motive Power for Street Railways." The report was read by Mr. John N. Beckley, President of the Rochester Railway Company, as follows:

REPORT OF THE COMMITTEE ON ELECTRIC MOTIVE POWER FOR STREET RAILWAYS.

Mr. President and Gentlemen: Last May I received a letter from the president of this Association asking me to prepare a report to be read at this meeting, "on any subject covered by the range of electric motive power for street surface railways." In that letter, the president, seeking to lure me to my destruction, stated that many months would yet elapse before the next meeting of the Association, and closed by expressing the hope that I would oblige him personally by complying with his request. I have been in so many situations where I have found it necessary to call upon my friends to oblige me that I could not find it in my heart to deny the president this request, especially as my promise, if made, was to do something months hence, I attached a string to my promise in the concluding part of my letter of acceptance, in which I stated that I did not see how I should get time to prepare anything worth the hearing, but that I would do my best.

I expected, when I agreed to write something for your consideration, that I would have an opportunity, before preparing what I had to say, of talking with the president of this Association, and of obtaining from him some suggestions upon which I might hang the slender thread of my thought. That pleasure, by reason of his and my business cares and engagements, has been denied me, and only the other day I was brought up with a round turn by a letter from the secretary reminding me that I had agreed to prepare a paper for this meeting upon the subject of "Electric Motive Power for Street Surface Railways." The reminder that the time had come for the fulfillment of my promise was almost as disagreeable to me as an electric shock administered by a 500 volt current, but the unpleasant features of that situation were considerably modified by the statement that the secretary, or some one acting through him, had been kind enough to formulate and put into quotation marks for me a definite subject for my paper. The fact that the subject is deeper than any well and wider than any church door is, to be sure, a little embarrassing. I am encouraged, however, to say what little I can upon this very comprehensive subject by the knowledge that, while I know really very little about it, yet there may be some others engaged in the street railway business who have had less experience in the operation of street surface railroads by means of this unseen and wonderful force called electricity.

The subject which has been given to me is many sided. I shall endeavor to throw out a few suggestions, based upon some study of the problem of street railroad transportation, and upon a little experience. If, in what I shall say, I am able to furnish one or two texts for discussion, I am sure there are those present who, by their discussion of the texts, will furnish all of us with valuable information and food for thought, and thereby my purpose will have been attained.

Most of us are engaged throughout all of the working hours of each day in the performance of duties which leave us little time for reflection upon, and study of, the broad questions suggested by the subject which has been given to me. We all know that the tendency of modern American life is toward the concentration of vast masses of people in our towns and cities, and that this urban increase is somewhat at the expense of the agricultural communities. We also know that the American workman, as well as the American business and professional man, is seeking to locate his home some distance away from the section of his town or city where his business is transacted or where his work is done. Every householder has, or desires to have, at least a little patch of lawn or garden about his home, to obtain which he must locate some distance from the business or manufacturing center of the town or city where he lives. To the average man, however, this is not possible, except as he can have some means of communication with that business or manufacturing center at low cost to him. But as towns and cities grow, and distance becomes more and more an element to be considered, it becomes necessary that the citizen should have not only facilities for cheap transportation for himself and the members of his family, but that he should have means of rapid intercommunication. Out of the needs of modern city and town life grew the horse railroad. The development of cities and towns brought with it the necessity for quicker transportation. The American intellect, ready to meet every emergency, set itself at work to devise some method of quickly transporting the people of the great cities of the country, and, so far as the great cities are concerned, practically solved the problem presented by inventing and building cable railroads. It was soon

found, however, that, while cable railways answered the purpose for which they were designed in cities like Chicago and Philadelphia and New York, they would not do in smaller cities, except in isolated cases where vast numbers of people were required to be moved daily over a comparatively short mileage.

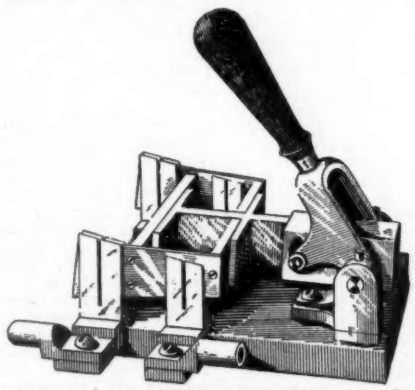
Five years ago the only street surface railways which were in successful operation anywhere in the United States were horse and cable railways. Within that five years more than 4,000 street cars have been electrically equipped, and to-day more than 3,000 miles of track in 300 cities and towns of this country have been constructed, on which these electric cars are run with satisfaction to the people and, in the main, with profit to the companies operating them.

The development of the street railway has had as much to do with the growth and prosperity of the towns and cities of this country as, or, perhaps, more than, any other one thing. The transportation of people by street railroads is most intimately connected with the social and business life of the people. Nearly 500 cities in the United States have street railway systems in operation. More than 800 corporations are operating street railways in such towns and cities. As many as 30,000 street cars—horse, cable and electric—are to-day running upon the 8,000 miles of street railroads in this country. In these cars and on these tracks are carried as many as 3,000,000,000 of people yearly, or 50 times the population of the United States. When we consider that the number of people carried by all of the steam railroad companies in all of the States of this Union last year is estimated at less than 500,000,000, and that more people are carried on the street surface railroads in the city of New York, in a year, than are carried by all the steam railroads of the State in the same period, we come to have some conception of the immense importance to the people of the rapid, efficient and safe service of street cars in the rapidly growing cities and towns of this wonderfully prosperous country. Think for a moment of the daily loss to the people of any city where horse cars are run at from four to six miles an hour, as compared with the operation in the same city of electric or cable cars, running from six to twelve miles an hour. Consider the immense increase in the value of property in our municipality, caused by the introduction of rapid transit. Consider the wholesome influence upon the people of every community where the husband or other head of a household, is able, by means of facilities of quick transportation, to take his midday meal with the members of his family. The best thought of this time may well be expended upon this great question of furnishing quick, safe, cheap and comfortable transportation to the people whose lot it is to dwell—as dwell they do in such vast numbers—in the towns and cities of this land.

The problem which is presented to the street railroad man of to-day must be considered, not simply with reference to the populations as they now exist, but with reference to the great increase of population which is certain to come. There are 74 cities in the United States, which have a population in excess of 40,000. The total population of these 74 cities, as shown by the last census, is nearly 13,000,000, and the average increase of population in these cities during the last decade is nearly 47 per cent. In this State there are 28 cities having a population in excess of 10,000 and a total aggregate population of nearly 3,500,000. The average increase in population of these cities, in the past 10 years, has been more than 33 per cent. For all these growing towns and cities in our own State, and throughout the country, what can electricity do as a motive power for the operation of their street railroads?

We, who have had to do somewhat with the change of the system of operation of street surface railroads from horse to electric power, know that we have now passed beyond the experimental stage, and are beginning to tread upon ground which seems firm under foot. We hear, now and then, fears expressed by doubting Thomases as to whether the motors are going to last, as to whether the repair bill is not going to wipe out all profit, and as to whether the great expenditure which has been, and is being made on our railroads, may not be thrown away, because some new and wonderful principle is to be discovered which will enable our railroad companies to operate their roads with commercial success by means of storage batteries. We find in some communities so great a prejudice against overhead wires that railroad companies are unable to obtain the necessary franchises and privileges, the granting of which would result in giving those communities the benefits of rapid transit with electricity as a motive power. Hour by hour, however, experience is teaching all doubters that the problem of rapid transit for cities has been solved, and that the trolley has come, and come to stay.

As this convention is held in the city of New York, where as yet the people have not had a practical demonstration of the merits of the trolley system, it may not be inappropriate to look at this question from the point of view of the New York citizen, and to meet, if we may, some objections which are here urged to the trolley system, so-called. I have read with some interest much that has appeared in the great New York dailies with reference to the horrible condition of things which exists in towns and cities where the trolley system is used for street car propulsion. Our friends over in Brooklyn have been endeavoring, since the last meeting of this Association, to educate their townsmen upon this matter, and with at least a reasonable measure of success. To them, and indeed to all of us, the facts which are perfectly well known have become trite from iteration. Everybody knows that a rapidly moving car, whether the propelling force is furnished by horses, by steam power exerted upon a steel rope, or by electricity, will hurt, and perhaps kill, the person with whom it comes in contact, but the rapidly moving car is essential to rapid transit. An electric car can be stopped as quickly, indeed, more quickly, than can a cable or horse car, running at the same rate of speed. Collisions occur with one system of transportation as much as with another, but we contend, so far as the danger question is concerned, that the only danger to life or limb from the operation of electric cars comes from the possibility of collision with persons or vehicles, and that there is no danger from the electric current itself propelling the car. As I have stated, electric cars have been operated during the past year on more than 2,500 miles of track, and, although millions of people have been carried upon these cars, no instance can be given of serious injury to any person by reason of shock caused by the electric current. We contend that the electric pressure used in the propulsion of street cars is below



NEW SWITCH OF THE HUNT ENGINEERING COMPANY.—(See page 75.)

the danger limit. We know that a railroad operated by electricity is a pleasant railroad to ride upon. The cars are started and stopped on such a railroad easily, and without jerking. On such a railroad we do not see horses frequently struggling beyond their strength to start a loaded car or to haul it up a grade. As we ride on such a railroad, we experience a sense of exhilaration as the car swiftly and safely speeds along, and unless our attention is specially called to the trolley wire overhead, we do not even realize that it is there. Only last week many people who reside in the city of New York had an opportunity of observing some of the advantages of propelling cars by electric power under hard conditions. Those in attendance upon the Republican State Convention, at Rochester, indulged, in the evening after the nominations had been made, in an impromptu celebration in front of the leading hotel of that city. The street in front of the hotel was completely blocked with people listening to the speeches and admiring the fireworks. The electric cars were, however, kept moving throughout the entire evening, and as several of the lines in operation in the city passed in front of the hotel, it was necessary for the cars to feel their way through this vast crowd. During the time of the celebration between 40 and 50 cars passed through the concourse of people, moving, if need be, at a snail's pace, backing when necessary by the reversal of the current, and without, in the slightest degree, injuring a single person. Cars drawn by horses could not have gone through the crowd in safety. I believe that every person who witnessed that sight, no matter how prejudiced he may have been before, was convinced that the operation of street cars by electric power is safe.

There is, however, one objection, which is urged with great insistence, especially in the city of New York, to the trolley system, and that is to the trolley wire itself. There is not the slightest danger in putting up or maintaining the trolley and necessary feed wires if the work is done in a proper manner, and if reasonable care is exercised in their maintenance, except as these wires are made dangerous by the telephone, electric light or telegraph wires placed above them. If the telephone, telegraph and electric light companies would take as much pains in putting up and maintaining their wires as do the electric railroad companies, there would never be any occasion for complaint, so far as danger is concerned, and then the only objection which could be urged to the maintenance of the necessary wires to operate electric cars would be their so-called unsightliness.

It must be conceded that poles, however shapely, and wires, however well put up, do not improve the appearance of city streets, but quite the contrary. But experience has shown that except as poles be set and wires strung, electric roads cannot be made a commercial success, and, therefore, without poles and wires electric railroads will not be operated. Hence the question presented to the people of a city where the population is not large enough to sustain a cable railroad on a given line is this: Shall we have rapid transit by electric motive power and waive the sentimental objection to the maintenance of a few light wires 18 or 20 feet above the surface of the street, or shall we have slow transit by horse-power with its many disadvantages and disagreeable accompaniments, and be rid of the wires? The question is being answered almost every day in the towns and cities of our country in favor of electric rapid transit.

The question is often asked by officials of street railroad companies who are contemplating making a change from horse to electric power, What is the cost of operation of an electric railroad, as compared with the cost of operating a horse railroad? I propose to state some experience which electric railroad companies have had upon this subject, and to answer the question as well as I can.

You have undoubtedly all seen the census bulletin, prepared by Mr. Cooley, upon the relative economy of electric, cable and animal motive power for street railways. Those of you who have seen this bulletin and studied the tables which Mr. Cooley has prepared, must have felt that, so far as electric roads are concerned, the information upon which they are based is very inadequate and unsatisfactory.

Four of the electric railroads, the reports of which furnished information for his table, had been in operation less than one year at the time those statistics were furnished, and the electric railroad which commenced operation earliest extended no further back than May 1, 1888. The average cost of operating the ten electric railways taken for purposes of comparison by Mr. Cooley is, in round numbers, 13 cents per car mile, while the average cost of operating the ten railways operated by animal power is, in round numbers, 18 cents per car mile, and the average cost of operating the ten cable railways is, in round numbers, 14 cents per car mile. Mr. Cooley gives, as the total average cost of road and equipment per mile of line with cable power, in round numbers, $850,000; with electric power, in round numbers, $46,000, and with animal power, in round numbers, $71,000. There is little value, however, to be attached to comparisons of this character. Everybody knows that it costs less to construct and equip a horse railroad on a given line than an electric railroad, and that it costs very much more to construct and equip a cable railroad than an electric railroad. Of course, in determining the question of economy in operation, the first cost of construction and equipment is a very important element for consideration, as well as the actual cost of maintaining and operating the railroad, whatever the motive power, when once completed. It seems more profitable to avail ourselves of comparisons which have been made by surface railroad companies operating a part of its system by electricity and a part by horse-power. Fortunately, we have gone far enough in electric railroading to be able to obtain sufficient facts to enable us to make an intelligent and trustworthy comparison.

This company which has had the greatest experience as to these matters is the West End Street Railway Company, of Boston. That company has published a statement showing its earnings and expenses, both with the electric and horse car system, for the months of April, May and June of this year. I ought perhaps to state that, as it seems to me, the conditions involved in the consideration of these questions are so diverse in different cities that the only proper basis of comparison of cost of operation is the cost per car mile. It is quite common for the street railroad officials to consider this question of the relative cost of operation upon the basis of a percentage of gross receipts. It will be readily seen, however, that this basis of comparison is necessarily misleading and inaccurate. The other basis is not exact, but approaches at least approximately to exactness. The total expense, as shown by the West End company, for motive power, car repairs, damages, wages of conductors and drivers, and all other expenses per mile run with electric power, during the three months mentioned, was as follows:

April	21.75 cents.
May	22.36 "
June	20.37 "

The total expense per mile run with horse-power for the time mentioned, was as follows:

April	24.54 cents.
May	24.04 "
June	23.52 "

Earnings upon the two lines, during the period under consideration, with the two systems, were as follows:

April—Electric	34.05 cents.
May— "	33.48 "
June— "	42.71 "
April—Horse	31.77 "
May— "	34.22 "
June— "	36.85 "

It will be observed that the earning power of the electric cars is considerably in excess of that of the horse cars, and that the expense per car mile is considerably below. The West End Company states that the electric cars of this company are run on the longer and less remunerative lines. If this be true, the showing made is very greatly in favor of the electric car from a commercial standpoint.

Permit me to refer to the experience of the company at Rochester, with which I am connected. In the month of May last the Rochester Railway Company operated 44 18-foot vestibule electric cars. The gross receipts from passengers riding on these cars during the month was $37,053, or 23.15 cents per car mile for a mileage of 159,567 miles. The total expense of operation of these cars for that month was $18,332, thus leaving a net profit of $18,721. The total cost of operation per car mile was 11.4 cents, and the profit per car mile was therefore 12.11 cents. It may be observed in passing that the operating expense was a trifle under 50 per cent. of the gross receipts.

The cost of operation was divided as follows:

Motive power	2.8 cents.
Car repairs	.7 "
Conductors and motormen	4.9 "
Other expenses	3 "

During the same period the company operated 62 horse cars, all of them without conductors. Most of the horse cars were one-horse or bobtail cars. The total cost of operating the horse cars without conductors during this period was about 10 cents per car mile, but the total receipts per car mile were but little above 12 cents.

In the month of June the Rochester Railway Company operated 54 electric cars and 60 horse cars. The electric cars earned each per day $23.60, or 22.77 cents per car mile, and the total expense of operating them per day was $10.50, or 11.07 cents per car mile. The cost of operation per car mile was divided as follows:

Motive power	2.40 cents.
Car repairs	1 cent.
Conductors and motormen	5.66 cents.
Other expenses	2.01 "
Making a total per car mile of	11.07 cents.

The cost of operating the horse cars during the same month per car mile was 11.06 cents, and they earned 14.37 cents per car mile. These illustrations are fairly indicative of our experience in Rochester month by month. My experience in the operation of street railroads has convinced me that the most economical system of operation is the electric system. I have not, in the statements which I have now made, taken into consideration the greater fixed charge in the operation of an electric railroad as compared with a horse railroad, due to the much greater cost of the former; but in arriving at the conclusion which I have above expressed, due consideration has been given to this element of increased cost. We know that when a horse railroad is changed over and operated by electricity the receipts are very largely increased. It is safe, in any case, to say that the increase in gross receipts will be at least 15 per cent.,

and the average increase is probably as high as 30 per cent. Some of this increase is undoubtedly due to the greater mileage which the cars make, and still more is due to the cleaner, more rapid and more comfortable transportation of the people.

We have reached the conclusion also that the bugaboo, which formerly somewhat frightened us, of the cost of maintenance and renewals of electric motors, need frighten us no longer. We have had motors in constant service on one of the first electric lines equipped in this country, namely, the line extending from Rochester to Charlotte, and these motors seem as efficient and in every way as satisfactory as they did the first month they were operated. We have, of course, renewed various parts of the motors, and we have replaced gears which have worn out, the expense of which has gone into the cost of maintenance. But the motors are still there, doing their work, and likely, with proper care and renewal of parts, to be doing their work 10 and even 20 years from to-day. The cost of maintenance and renewal of parts has not been so large as to carry operating expenses up to anywhere near the expense of operating the same number of cars, at the same mileage by animal or cable power.

Those who propose to substitute electric for horse power will make a great blunder if they attempt to put in cheap construction or material. We who have gone into this matter have learned that the track upon which it is proposed to operate electric cars should be o. girder or T rail, of not less weight than 50 pounds to the yard of T and 62 pounds to the yard of girder rail. The weakest place in the track is, of course, at the joint, and no cheap contrivance at that point should, on any account, be permitted. With girder or T rail construction it is, it seems to me, a useless expense to lay a continuous supplementary wire. The rails should, of course, be well and heavily bonded at the joints with iron, not copper, wire, and cross connection of rails should be frequently made. Where tram rail track is used I think a continuous wire should be laid and connected with the bond wires.

The overhead wire cannot be too well put up. Cheap devices should never be used because they are cheap. The best and strongest are none too good. In putting up the feed wire and putting in the ground wire return to the generators, do not spare copper. I am convinced that much that we have heard about the inefficiency of generators and motors is due to trying to get too great a quantity of current through too small a quantity of copper. In the power station do not make the units too large. Accidents will happen as long as machinery is run, and an accident to a 500 horse-power plant is serious, while you can keep your cars or most of them moving, if one of two or three small engines break down. The same rule, of course, holds as to the generators.

Always put in a condensing steam plant. One large item of expense of operation is the coal bill. Cut that down at least 40 per cent. by erecting condensing engines. The first cost is, of course, a little more, but your stockholders, as they examine your statements of operation in the years to come, will say you were wise in your day and generation.

Locate your power station as near as may be in the center of your system, but, above all, if possible, on a stream large enough to furnish all the water you require for the boilers and condensers. City water, where your consumption runs into the millions of gallons fast, is expensive.

It seems to me a mistake to equip a car body of greater length than 18 feet, and I think a 16 foot car is better still. During the hours of the day when travel is heavy, it is easy to pull a trailer, and when traffic is light, you are not then using up your power in hauling around a great lumbering double truck structure practically empty.

A great many companies have had trouble with their motors. The chief reason for this trouble has been that their motors have been too light mechanically and too economically built electrically to stand the strain. All the manufacturing companies have learned their lesson, and to-day most of the motors put upon the market are strong enough mechanically and electrically to perform, under proper conditions, the work expected of them.

The managers of electric roads, if they are to be made successful, must learn that the greater earning power is no excuse for extravagant management, and that the difference between success and failure is often a narrow one. Everything depends upon taking the stitch in time. A loose belt, an imperfect connection, any one of 40 little things, may result in serious damage and consequent financial loss. I do not know of an electric railroad anywhere where the overhead single trolley system is used which ought not to be successful. I know of some which have not been. In some cases cheap construction accounts for failure, and, in some others, careless management or reckless extravagance is the cause of the failure. The scrap heap about an electric car barn or machine shop often tells a significant story. In intelligent supervision and painstaking watchfulness is found one great secret of commercial success in this business, as well as in most others.

Every manager should keep a record of the items which go to make up operating expenses, and those responsible for management should carefully study these statements month by month with a view of lessening the expense of each item. An intelligent and careful examination of the cause of accidents to parts of a motor will often be the means of preventing the recurrence of troubles in the future.

So far as possible, motormen, as well as conductors, should be made to understand the mechanism of the machines which propel their cars and the function of each part. Thereby they are made ready to act promptly and intelligently in case of trouble with a motor.

The directors of some companies, because of their desire to make handsome returns to their stockholders, have paid out in dividends money which ought to have gone back into the road. The proper policy to pursue in all cases is the building up and bettering the plant out of earnings, so far as necessary, even at the expense of cutting down dividends.

The field in which we are working is a great one. There is in this field abundant opportunity for the intelligent, progressive and sagacious business man. The primary object which the management of a street railroad seeks to attain is business success, but success in that direction cannot be had without great resulting benefits to the people of the community served by the railroad operated. We should not lose sight of the fact that we are engaged in a work, the successful performance of which builds up communities, aids business enterprises and makes the life of the people in those communities better worth living.

Respectfully submitted,

JOHN N. BECKLEY, *Committee.*

It was moved that the report be printed forthwith, and, with copies of the address of the president, be distributed to all street railway companies in the State.

The President then declared the subject of "Electricity" open for discussion, and invited representatives of electrical equipment companies to participate.

Mr. Charles A. Benton, representing the Rae system, addressed the delegates briefly. The system, he said, was unique in itself. They manufactured a single motor made in three sizes, 15, 30 and 40 horse-power. The peculiar advantage claimed for the system is that it gives to both axles a traction on the rails which cannot be got by any other system. He said, that the company was the smallest represented at the meeting and the most recent in the field; but he could state, with justice to the system, that it had made in some places a respectable record.

Mr. C. C. Curtis, of the Short Electric System, followed. He said: When this convention met in Rochester last September, the Short Company came before you and made some very strong promises as to the showing that would be made when the road in Rochester was started. What that showing has been you have heard in the very able report that has just been read. The question in which you are all vitally interested is the question of repairs—repairs to your motors, repairs to your lines, and repairs to your generators. In the city of Rochester there has been kept, day by day, an accurate record of the motor and generator repairs. That road started running last November, and giving it eight months of run, through the Winter months, the hardest months in the year, up to the first day of August, the average cost of repairs per car mile was four mills. This is a very fine showing, as I think every gentleman who has kept a similar record will admit. The report just made gives the total repair account. That repair account, as given month by month by Mr. Beckley, will, of course, include the repairs of the line, generators, motors, rail, etc. When I say four mills per car mile, I mean only the repairs on the generators and the repairs on the motors; that is, the electrical repairs. In Muskegon, Mich., where we have been running about a year and a half, our record shows two mills per car mile. We have two new motors to offer to you. We are prepared to give you the double reduction motor, or the single reduction motor, and the low reduction motor. You know how great and excessive the repairs of gears is. One of the gentlemen who was on the floor of this convention stated to me a month ago, that, in his judgment, if our gearless motor was really what we claimed for it (and we are prepared to back up our claims with strong guarantees,) it would save his company 75 per cent. of the repair account. If this is true, no road should be equipped without looking carefully into the merits of this Short gearless motor. The armature of this motor is hung on a sleeve. This sleeve surrounds the axle. The weight of the motor is thus distributed over the whole motor frame and not on the axle of the cars. There is an air space of about three-quarters of an inch between the axle of the car and the inner surface of the sleeve on which the armature is hung. By removing four bolts you take off the lower wheels and raise one end of the car and you roll out your armature and the car axle. You are, no doubt, more or less familiar with its construction. Should a bobbin burn out it can, because of its peculiar construction, be repaired for from two to three dollars. As you may know, these bobbins are only about three-quarters of an inch deep and surround the outer circle of the armature. They are not connected, and should one burn out, it does not interfere with or necessitate the burning out of any of the others. The hue and cry has been raised that the gearless motor is a very nice thing theoretically, but in practical operation it is going to take an enormous amount of current. I have a report of a test made in Cleveland, Ohio, about two weeks ago, by Mr. Al. Johnson, with whom, no doubt, many of you are acquainted. It was a trial between one of his cars and one of the Short gearless motor cars. These two cars ran over the Brooklyn street railroad line, running about 20 minutes apart, doing commercial work. The gearless car checked up some 80 passengers, and the single reduction motor, which Johnson was running, checked up 47. The car ran for about two hours and a half, and we have the half minute readings. The report and the readings show that the single reduction motor takes 24 per cent. more current than the gearless motor. We have this gearless car all equipped in Cleveland, and we give you all a cordial invitation to come and see it and examine it carefully. Mr. M. K. Bowen, of our company, would like to say a few words to you on the Short generators.

Mr. M. K. Bowen: I want to say a few words to you in regard to our dynamos or generators. We make them in five sizes, 75, 100, 150, 300 and 500 horse-power. The peculiarities in the construction of our dynamos are in keeping with the peculiarities in the construction of our car motors. The bobbins are separately wound and connected in series. They are exposed to the air around the side, being thoroughly ventilated. The field coils are both series and parallel wound. The shaft is provided with self-oiling bearings, near the commutator, which is extraordinarily large—being about 20 inches in diameter. Near the commutator is provided a bar which regulates all thrusts, so that there is no danger from displacements.

Mr. George W. Mansfield, representing the Thomson-Houston Electric Company, next addressed the meeting. Being connected with an electrical company, possibly I am not supposed to know much about the railroading part of it, outside of the purely electrical apparatus. But, unfortunately for some of our customers, they have had to come to us for assistance; and through our rendering assistance we have, perforce, had to come into the operation and management of a number of railroads throughout the country. Therefore, in a certain sense, we do understand something about the operation of electrical cars, and what they are doing and what they are supposed to do and what the public and the officials of the railroads want them to do. Mr. Beckley's paper was exceedingly interesting. He dealt with the subject in a broad and wholesome way. I think, on the whole, it was one of the broadest papers on the subject I have ever listened to. Our company endeavors to do what it does do well. It went into the field early. It struggled hard to produce a motor to meet all of the conditions that were to be imposed upon it; and I tell you these conditions were severe. It is not only a lack of knowledge on the part of the railroad officials, but a deep-rooted prejudice on the part of the public against the electric system that we have to meet. Then again, I am sorry to say, we did not get the support we should from the builders of the other portions of the railroad equipment. They did not evince a spirit of accommodation to see if they could help us in the combination of their manufactures and ours. I am glad to say, however, that matters in this respect have very much improved. We have put our motors under almost every style of car that is built, they have been used with almost every style of truck that is built, and on almost every kind of road that is built. We have them in the hottest climes, away in Brazil, and in the coldest climes, up in Vancouver, or in Maine. I believe you are all acquainted with our product, and it does not need any extended remarks of mine to describe them in detail. We manufacture every part of an electric system. We are constantly endeavoring to so arrange and harmonize the whole of the overhead parts that we will have a complete system. We are doing the same with all of the apparatus on the car; lightning arrester, reversing switch, trolley poles and bars, motors, fuse boxes and the controlling mechanism. We are happy to have all suggestions from railroad men possible. I believe firmly in the single reduction motor. We have in the neighborhood of 1,200 of them in operation. We have been manufacturing them since the first of last February, having made them to put out upon some small roads for experimental purposes last Summer. We are also making experiments with gearless motors, etc.; but I believe that we should pin our faith to that which we know is absolutely satisfactory. We are building our generators large—now furnishing generators of 250 and 300 horse-power. We are also building some of 400 and 500 horse-power. The 400 horse-power motor will quickly be put in operation; we are at present making tests with it at the factory. In every respect, from the details of the overhead system down to all of the electric parts of the car, we produce them all. I want to impress this fact upon you, that you have not to come to us for a motor, and then go to some one else for the overhead part, and so on; but come to us for the whole of it. There is another thing which interests all of you gentlemen, and that is the question of snow. It is said that electric cars have not earned the reputation they should have in regard to handling snow; and that electric roads are still dependent, to a great extent, upon horses and the muscle of men in removing snow; but that is not entirely so. Our company has endeavored to evolve a plow and a broom sweeper which will demonstrate that electricity is absolutely self-contained in every respect. I would like the convention to hear Mr. Barr, of our company, who represents it in that respect.

Mr. Barr, of the Thomson-Houston Company: Our company has gone thoroughly into this question of snow-cleaning devices. Some of you may know that last year we got out a machine—a snow sweeper—which, in a great many cases, has done excellent work and given good satisfaction. There were some defects in that machine, however, which we have tried to remedy this year. With this point in view, I early last year made a trip through the country and personally inspected all of the devices, of which I could learn, which were used by street railroads, steam railroads and cities for sweeping streets. From the information obtained, four of us—all practical men—mapped out a general line to follow. I may say to those of you who are not familiar with the machine we had last year, that it was a brush of rattan set at an angle of 60 degrees, revolving in front of a frame driven by a motor by means of sprocket chains. In a light sugar snow that brush gave good satisfaction; but in a heavy, wet snow the brush would clog, and served rather to pack the snow on the rail and make it solid, and, therefore, rendered it impossible for the wheel to get traction. The sprocket chain is always a source of trouble and annoyance. The lines were laid down to follow, first, to do away with the rattan broom, and second, to get a positive drive for the cylinder. We have built a broom with steel teeth. It is supported from 36 inch 400 pound wheels on a 22a Bemis box. The wheels are driven in the same way as with cars, placing the motors on the axle. We are using single reduction motors for them. The cylinder is set at 45 degrees of the track, extending completely across, and is hung from a rocker shaft. The motor counterbalances the blade of the broom around that shaft and is geared directly through spur gearing to the flyer. The main feature of the flyer is that it has a series of blades. The best description of of it is to refer you to the paddle-wheel of a steamer, only of smaller diameter, having the blades cut at the centre, to allow the spur gearing for the driving. These blades are of steel plate, about a quarter of an inch thick, and there are eight of them on each flyer. To the back of the blades are bolted steel brushes, the brushes being made of flat steel wire, cutting edgeways. These brushes are adjustable, and ordinarily their surfaces project from five-eighths to one and one-half inches beyond the blade. The blade does the major part of the work. It breaks the heavy snow, and will actually cut ice. The steel brush does the rest of the work. It sweeps the road clean, and, if allowed to remain long enough in one place, will cut the ice as well. The motor driving the broom or brush is independent from the motors driving the car, so that the sweeper can be propelled in a light snow at a speed sufficient to keep it ahead of any of the cars on the line. If you should meet with heavy snow or ice on the track the sweeper can be slowed down, the brush still keeping its normal speed. By doing this these brushes being made of steel or wire, will actually cut the ice clean down to the rail. The whole thing is very novel, but it has done good work. We have experimented some with a new machine, somewhat different from the old one. Where the latter had only four blades, the new one has eight; the old one was set at 60 degrees angle, the new one at 45; in the old we used the sprocket chain, in the present the spur gearing; we had a 10 horse-power motor, but now have a 25; in the old one the blade made 80 turns a minute, in

the new one it will run up to 150 turns a minute. We are building several of those machines, one of which we shall have on exhibition at the convention at Pittsburgh.

Mr. H. W. Grannis, representing the Westinghouse Electric and Manufacturing Company, said: There is one point touched upon by Mr. Beckley in his very interesting paper, attention to which, I think, has given us success in the manufacture of street railway motors. I refer to his reference to the point of mechanical construction in the motors. I will not occupy your time to any extent, but will go into history for a moment to tell you what the Westinghouse Company has done since it began manufacturing street railway motors. Our first motor was constructed a little over a year ago and put in operation July 4, 1890, in Pittsburgh. It was the old type double reduction motor, all the parts enclosed in cast iron frames. All shafting was run parallel at all times, and the gears kept in perfect alignment. In addition to that, I think we first adopted the old device of enclosing the gears in gear-boxes filled with grease. This eliminated the noise and a large part of the wear and tear. That motor is still in operation. I cannot tell the expense for repairs, but they were infinitesimal. Within five or six months succeeding the introduction of our motor we equipped a number of roads with double reduction motors, all in successful operation to-day. In January last we got out another motor, single reduction, having many of the general features of the old double reduction motor. This motor had several improvements over the other. We used a different resistance box. The other worked fairly well, but there was a little trouble. With the new motor we used only galvanized iron wire, and it has given us no trouble in a single instance. It is open and ventilated. We made a slight modification of our controlling device. Formerly it was a wooden shaft with brass contact strips screwed to the shaft. We found that was not quite as durable as we wished, and we are now making them of asbestos and brass. If they do wear at all, it makes very little difference, for they are practically indestructible. We are manufacturing and selling many of these motors. In the first year of our business career we have put machines on about 70 different roads, which we think is about as good a record as any company can show for the same length of time. In April we commenced to get out a gearless motor, and have been operating that motor since May in Pittsburgh. It has exceeded our most sanguine expectations, and we will be ready in a few days to ship it. We have not said much about it for the past three or four months, for the reason that the single reduction motor did better than we expected. They are giving satisfaction wherever they are used. We therefore determined to wait and test the gearless motor thoroughly. This we have done, and to-day we stand before you with two motors to offer—single reduction and gearless. Personally, I express a preference for the gearless. It is simpler than any other. I do not see how it is possible to construct a motor with fewer parts than the gearless. I was interested the other day in reading on the subject of the underground railway in London, where electric traction is used, that the motors for the purpose of moving the trains had its armature mounted directly on the axle, which is the plan used by us. In that way, we need not have any devices communicating power to the wheels. We do not require any special wheels; any standard wheel will do with our system. The gearless motor has been running in Pittsburgh for some months. I have no doubt many of you gentlemen will be there next month, and you will have an opportunity to see it in all its details. We are manufacturing, as other companies are, different sizes of motors, somewhat larger than have been manufactured in the past, up to 250 and 500 horse-power.

Mr. C. J. Field, of the Field Engineering Company, next addressed the meeting. He urged the railway officials to always insist on the best class of construction work. This class of work always brought the largest return in the long run. Always get the best of everything. The result will be a reduction in the repair account and operating expenses, and the wisdom of getting everything of the best would eventually become manifest.

Mr. C. D. Shain, of the Edison Electric Company, followed: I would like to call the attention of the convention to our double and single reduction motors. We make the single reduction motor in sizes from 15 to 30 horse-power. Many roads adopt different size motors. It will be remembered that some years ago, when we commenced the manufacture of electric motors, they were from five to 10 horse-power. At the present time many of the roads are using very long and heavy cars, and many gentlemen do not think it necessary to put in more than 15 horse-power equipment on such cars. The result is a general disappointment all around, as the motors are too light for that purpose, and then they are equipped with two 15 horse-power motors. Where large cars are used sufficient power must be provided. We make a full line of electrical supplies of every description for street railway work, and we shall also present to street car men this Winter a snow plow and sweeper combined.

Mr. C. C. Bowen, of the Multiple Distributing Station Electric Railway Company, also addressed the meeting, when the electrical discussion came to a close.

The recommendation of the executive committee that the by-laws be amended so that companies whose annual gross receipts from passengers is less than $100,000 may be admitted to membership upon the payment of nominal annual dues, viz., $5, was adopted.

The president appointed Messrs. John N. Partridge, of Brooklyn; Henry M. Watson, of Buffalo, and John W. McNamara, of Albany, a committee to nominate officers and report a place for the next meeting.

The following officers were elected for the ensuing year:

President, John N. Beckley, Rochester.

First vice-president, Thomas H. McLean, New York city; second vice-president, George Law, New York city.

Secretary and treasurer, W. J. Richardson, Brooklyn.

Executive committee: President and secretary, Daniel F. Lewis, Brooklyn; C. Densmore Wyman, New York city; Charles Cleminshaw, Troy.

Saratoga Springs, N. Y., was selected as the place for the next meeting of the Association, which will take place on the third Tuesday in September, 1892. The meeting then adjourned.

All in attendance at the convention were photographed in a group in front of the hotel just before luncheon, and after luncheon the party, as the guests of the retiring president, Mr. Daniel F. Lewis, went for a drive through Central Park and along the Riverside drive to High Bridge and Fort George.

In the evening Mr. George Green, proprietor of the Hotel Metropole, tendered a complimentary banquet to the Association, to which all in attendance at the convention were invited. About 50 gentlemen composed the party. It was of an entirely informal nature, although everything necessary to make the occasion thoroughly enjoyable was bountifully provided. There was some brief speechmaking indulged in, and shortly before nine o'clock the gathering dispersed.

Hunt Engineering Company's Switch.

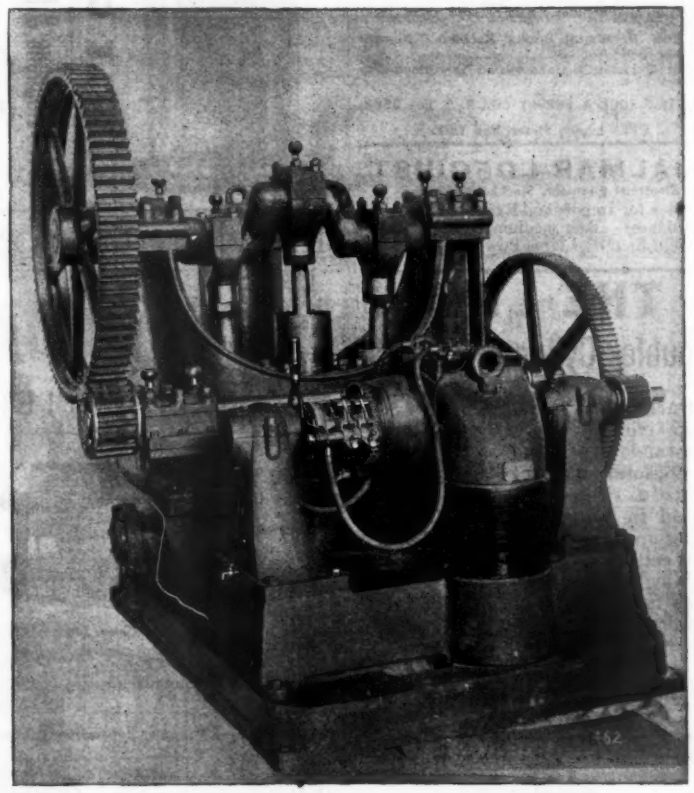
A new double-pole, quick-breaking switch has just been patented and brought out by the Hunt Engineering Company, of Brooklyn. The mechanical devices used for releasing the knives from the brushes and making a quick break are claimed to be entirely original with the Hunt Engineering Company, and while they are extremely simple, they are most effective and satisfactory. Prominent electrical experts have examined this switch and have pronounced it to be one of the handsomest and most complete switches that has ever been put upon the market. The whole switch is mounted on a slate base, with the terminals on the side and a pair of knives insulated from each other and carried on a highly polished bar, make and break the contact.

By an ingenious device, a fuse block is attached to the slate base of the switch and one terminal, so that at a slight cost fuse attachments can be added to the same.

The whole switch is made of highly polished brass and engraver's copper, and presents a most beautiful appearance. It is compact, not liable to get out of order, and is intended to be used in all grades of electrical work or for lighting and power stations. The switches are made in four different sizes, carrying one, two, three and four hundred amperes; special sizes are made to order. A cut appears on page 73.

The Goulds' Triplex Electric Pump.

The Triplex or three-cylinder pump, made by the Goulds' Manufacturing Company, possesses important advantages in combination with the Thomson-Houston electric motor. The pump offers absolutely even and unvarying resistance to the motor under all conditions, and consumes but a minimum of power in friction of parts. Careful tests of the outfit complete have shown a high efficiency. The three-throw crank shaft, in the stroke of which there is no dead center, prevents jerky motion and vibrations. The



GOULDS' TRIPLEX ELECTRIC PUMP WITH THOMSON-HOUSTON MOTOR.

pump and motor are mounted on one bedplate, and are practically one machine, being thoroughly tested as such before going into active service.

In villages or cities where power can can be had from electric light or power circuits, electric pumping offers relief from the discomforts of insufficient or hard and unfit water supply, and the hardly lesser trials of disagreeable, noisy and dangerous pumping engines in vogue.

One of the most troublesome questions in mining operations is the disposal of water. By the introduction of electricity for underground work the problem is greatly simplified. The necessity for long lines of steam pipe is removed, and in the place of hot steam pipes spreading dry rot in the vicinity, a small copper wire is suspended from wall or ceiling; or, the current may be taken from the trolley wire if the mine is equipped with an electric haulage plant. In some cases, where transmission from the surface by steam or compressed air was utterly impracticable, an underground steam plant seemed necessary, it has been found that the cost of excavating and drilling holes for the chimneys would exceed the total cost of the electric pumping plant.

The accompanying illustration shows a Goulds' pump and Thomson-Houston motor, the combination which has met with such success in the applications mentioned above, and which is handled by the Thomson-Houston Motor Company for ordinary pumping work and specially fitted for mining work by the Thomson-Van Depoele Electric Mining Company for all mining, excavating and metallurgical operations.

ELECTRIC LIGHT NEWS

—— J. W. Parker, the Philadelphia agent for the Ball Engine Company, of Erie, Pa., has sold an 80 horse-power engine to the Ivy City Brick Company, of Washington, D. C., also an 80 horse-power engine to George Kelly & Company, of Philadelphia.

—— Papers were recently filed in the circuit clerk's office, at Nevada, Mo., against the Nevada Gas and Electric Light Company, by the attorneys of the Missouri, Kansas and Texas Trust Company, to foreclose a mortgage of $80,000 held by the trust company.

—— The Dunellen Electric Light Company, of Dunellen, N. J., have just begun to light the streets of that town regularly, much to the satisfaction of the citizens. The Thomson-Houston system is used and operated by water power, which is estimated to be about 40 horse-power.

—— Several improvements and developments have been made in the electric light station at McKeesport, Pa., recently, and a new engine and generator have been ordered. This is made necessary in order to furnish power to the White Electric Traction Company, who will commence operating their new line this month.

—— The Syracuse, N. Y., Electric Light and Power Company have given out contracts for a new brick building to cost about $6,000. The additional room is needed to accomodate the 600 horse-power Corliss engine now being built for them by P. Allis & Company, of Milwaukee, and the eight generators the engine is to run.

—— The Manufacturers' Investment Company, of Madison, Me., are having installed one of the finest electric light plants in the State of Maine. It consists of both incandescent and arc dynamos from the works of the Thomson-Houston Electric Company, of Lynn, Mass. This is said to be the eighth pulp mill in the State installed with the Thomson-Houston apparatus.

—— The Salt Lake, Utah, Power, Light and Heating Company are making further additions to their electric lighting plant and have just placed a telegraphic order with the Pond Engineering Company, of St. Louis, for another 200 horse-power Armington & Sims compound engine. This is the sixth Armington & Sims engine which this company has purchased within a little more than a year.

—— The Schenectady Illuminating Company, of Schenectady, N. Y., which recently purchased the plant of the Westinghouse Illuminating Company, is at present engaged in blocking out the city in electric lighting districts and endeavoring to find out just what is wanted. The capacity of the new plant will be sufficient to furnish every office, store and dwelling with electric light.

—— The Berlin, Germany, Electric Works include five central stations, in which the needed electricity for the supply of the city is generated. In March, 1889, there were in the capital 3,714 arc lamps and 62,876 incandescent lamps in operation. For motor and illuminating purposes, the five central stations distribute about 8,000 horse-power, which will shortly be increased to 18,000.

—— Engineers Hull and Pemral, of Bridgeport, are perfecting plans for building a dam on the Housatonic River at Stockbridge, Mass., for the Monument mills. Power is to be furnished in this way for running a 600 horse-power electric light plant, from which the Monument mills will light their factories and also the village of Stockbridge. This is a definite move to utilize the water power of the Housatonic.

KINDRED INTERESTS

H. Ward Leonard & Company, Electrical Exchange Building, New York, have issued a neat little pamphlet called "How to Purchase an Electric Plant." It gives this new company's method of doing business and their charges for doing it.

Post & Company, 215-217 West Fourth street, Cincinnati, have issued a handsome catalogue of electric railway, electric light, telephone, telegraph and fire alarm supplies and annunciators. This company is one of the oldest and best established firms in the West, and they have a reputation second to none.

The Ball Engine Company, Erie, Pa. — The Bloomington Electric Co., Bloomington, Ind., are about to install a 150 horse-power Ball engine. The Hebrew Institute, New York City, are installing an 80 horse-power engine, furnished by E. T. Copeland, 106 Liberty street, New York city. The Dubois Traction Passenger Railway Co., Dubois, Pa., are installing a 100 horse-power engine, sold them by Dravo & Black, Pittsburgh, Pa.

The Standard Electrical Works, Cincinnati, will do the wiring in the elegant new City Hall, which has just been completed for the city of Cincinnati. The Standard Electrical Works are agents for the Western Electric Co. and the Okonite Company, having sold over $100,000 worth of wires and cables in Cincinnati and vicinity. The officers of the company, which has handled many large contracts, are E. V. Cherry, president; J. W. Herron, vice-president; and F. D. Lawrence, secretary.

The Thomson-Houston Electric Company, Boston, has just issued one of the handsomest and most complete catalogues we have ever seen. It is bound in stiff gray boards and beautifully illustrated and printed on fine paper. The catalogue emanates from the electric lighting supply department and consequently is representative of but a small portion of this company's immense business. The line of supplies manufactured by the Thomson-Houston Company covers a wide range and the intending purchaser can have almost any order filled by consulting this catalogue.

A Large Export Order.—The order taken for electric railway equipment by B. Blum, export agent for the Wenstrom Consolidated Dynamo and Motor Company, Baltimore, consisting of a 50,000 watt generator and station equipment, one and a half miles line and track material, and a specially designed motor car for a narrow gauge road (70 centimeters), was shipped, per steamship "Segurança," August 24, 1891. This plant is intended for Bahia, Brazil, and will be the first installation for passenger traffic to be made in that country. An order for 65 more cars is to follow the successful trial of this equipment. The order for this sample plant was placed on July 23, 1891, and was ready for shipment by August 12, 1891. When it is considered that the conditions of the road and roadbed are such as to present obstacles which have probably not yet been presented by any road in this country, and which had to be overcome by this special machinery, this order has been filled very quickly.

RECEIVER'S SALE.—Thomson-Houston Electric Light Company et al. vs. the Hughes & Gawthrop Company et al. No. 866, June term, 1891.

In pursuance of a decree of the Court of Common Pleas, No. 1, of Allegheny County, made on the 29th day of August, 1891, in the above-entitled case, the undersigned receiver of the Hughes & Gawthrop Company will expose to public sale, at the office of said company, corner of Fifth avenue and Market street, in the city of Pittsburgh, Pa., on Thursday, September 24, 1891, at 10 o'clock A. M., all the property of defendant company (except accounts, bills receivable and contracts in course of completion) in manner following: (a) Office furniture and fixtures separately; (b) all supplies and materials connected with annunciator and bell work in bulk; (c) all supplies and material connected with and used in arc and incandescent lighting in bulk. Terms cash.

For further particulars inquire of
S. M. HAMILL, Receiver,
Fifth avenue and Market street, Pittsburgh.
GEO. P. HAMILTON, his Attorney,
149 Fourth avenue.

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ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON SEPTEMBER 15, 1891.

459,422 Dynamo-electric machine and motor; Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Co. of Connecticut.

459,423 System of electrical distribution; Elihu Thomson, Swampscott, Mass.

459,447 Fibrous carbon battery; James H. Robertson, Rutherford, N. J., assignor of two-thirds to Charles G. Taylor, Montclair, N. J., and John B. Campbell, Brooklyn, and Roscoe H. Thompson, New York, N. Y.

459,448 Telegraphic apparatus; William E. Sloan, John E. Hughes and Orrin S. Reed, Chicago, Ill., assignors to the Vibro Telegraph Co., same place.

459,465 Electric switch; Boyd W. Allen, Boston, Mass.

459,485 Trolley wire connection; Robert L. Caldwell, Rochester, N. Y.

459,491 Method of making plates for secondary batteries; Stanley C. C. Currie, Philadelphia, Pa., assignor to the United Gas Improvement Co., same place.

459,508 Dynamo-electric generator or motor; John Hodnit, St. Louis, Mo., assignor of one-half to Carl Rueter, same place.

459,509 Conduit for electric wires; Henry W. Johns, New York, N. Y.

459,510 Electric arc lamp; Edward R. Knowles, Brooklyn, N. Y.

459,514 Incandescent electric lamp socket; John O. Phillips, New York, N. Y., assignor to the McCreary Electrical Specialty Co.

459,523 Cable box for electric wires; Jasper N. Keller, Newton, and John A. McCoy, Somerville, assignors to the New England Telephone and Telegraph Co., Boston, Mass.

459,535 Secondary battery; William L. Silvey, Lima, O., assignor to Catharine P. Silvey and Frank Silvey, Castleton, Ind., and Mary Silvey, Dayton, O.

459,556 Process of electrolytically obtaining zinc; Alexander Watt, London, England.

459,560 Cut-out; Frank Bryan, London, England, assignor to Woodhouse & Rawson, United, Limited, same place.

459,572 Commutator turning device; Arthur K. Bonta, Hoboken, N. J.

459,591 Electrical alarm system; John P. McMahon, Jersey City, N. J.

459,605 Electric push; John F. Wollensak, Chicago, Ill.

459,610 Dynamo-electric machine; Edmond Desroziers, Paris, France.

459,615 Annunciator; Foster Ritchie, Highland Park, assignor to Myron A. Knapp, Chicago, Ill.

459,678 Electric motor; John W. Davis and John B. Farrington, New York, N. Y.

459,681 Electric belt; Christian H. Dorenwend, Toronto, Canada.

459,689 Slide shoe trolley; Sidney H. Short, Cleveland, O., assignor to the Short Electric Railway Co., same place.

459,690 Rheostat for electric motor cars; Sidney H. Short, Cleveland, O.

459,704 Electrical fixture. 459,705 Electric light fixture. Edwin T. Greenfield, New York, N. Y., assignor to the Interior Conduit and Insulation Co., same place.

459,706 Electric snap switch; Gerald W. Hart, Kansas City, Mo., assignor of one-half to George S. Hegeman, Hartford, Conn.

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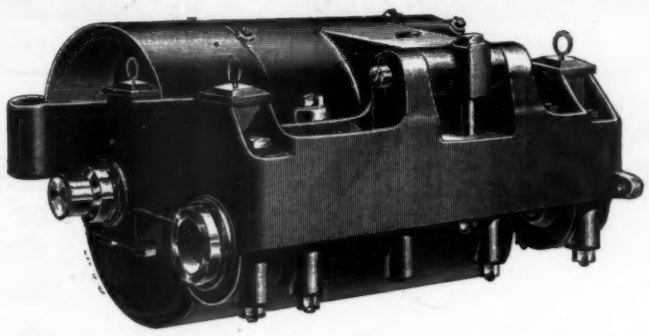

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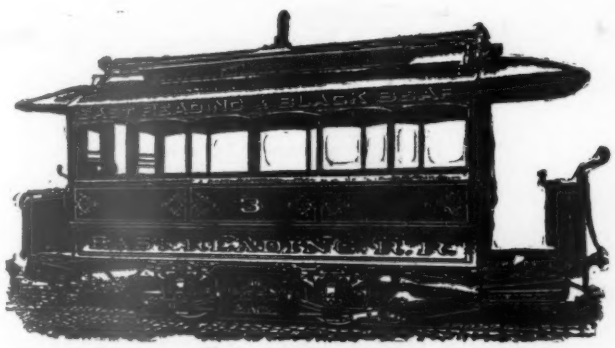

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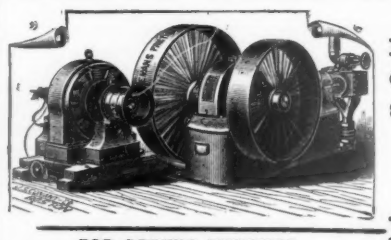

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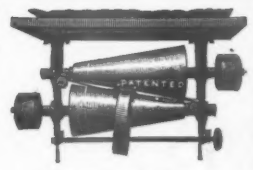

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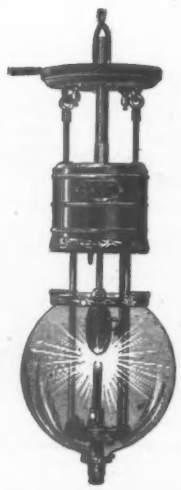

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